8. WASTE AREA GROUP 5 (AUXILIARY REACTOR AREA AND POWER BURST FACILITY)

WAG 5 comprises the Auxiliary Reactor Area (ARA) and the PBF.

The ARA consisted of four separate operational areas (designated as ARA-I, ARA-II, ARA-III, and ARA-IV). The ARA-II facility housed the Stationary Low Power Reactor No. 1 (SL-1) facility and numerous minor structures. The ARA-I facility was built to support SL-1. Both of these facilities were built in 1957. In 1961, an accident destroyed the SL-1 reactor, and ARA-I became the staging area for the SL-1 emergency response and subsequent SL-1 decontamination and cleanup.

ARA-III and ARA-IV were built in the late 1950s. The ARA-III facility initially housed the Army Gas-Cooled Reactor Experiment research reactor, and the ARA-IV facility was built to accommodate the Mobile Low Power Reactor-1. Experiments with the Army Gas-Cooled Reactor were discontinued at ARA-III in 1961. Work on the Mobile Low Power Reactor-1 at ARA-IV continued through 1964. In 1963, the ARA-III facility was modified to support tests at ARA-IV and remained active until 1965. ARA-IV was used to operate the Nuclear Effects Reactor Program from 1967 to 1970. ARA-IV is still in use as part of the Critical Infrastructure Test Range Complex.

PBF was built in the late 1950s. Initially, it was known as the Special Power Excursion Reactor Test (SPERT) facility and consisted of five separate operational areas: the Control Area and SPERT-I, SPERT-II, SPERT-III, and SPERT-IV. Later, operational areas at PBF consisted of the PBF Control Area, the PBF Reactor Area (SPERT-I), the Waste Engineering Development Facility (SPERT-II), the Waste Experimental Reduction Facility (SPERT-III), and the Mixed Waste Storage Facility (SPERT-IV). Collectively, the Waste Engineering Development Facility, the Waste Experimental Reduction Facility, and the Mixed Waste Storage Facility were known as the Waste Reduction Operations Complex.

Operations at ARA and PBF resulted in releases of contaminants to the environment. Consequently, these areas have been designated as WAG 5 under the FFA/CO (DOE-ID 1991). This CERCLA (42 USC § 9601 et seq.) remedial action is proceeding in accordance with requirements identified in four RODs. Tables 8-1 through 8-3 list the release sites that required remediation, the COCs at each site, and the cleanup goals for each site. Figures 8-1 and 8-2 show the CERCLA sites at ARA and PBF, respectively.

The first ROD, issued in September 1992, focused on remediation of the PBF corrosive waste sump (PBF-08 site) and evaporation pond (PBF-10 site) within OU 5-13 as part of an interim remedial action (DOE-ID 1992a). The second ROD, issued in December 1992, focused on the no-action declaration for the ARA-I chemical evaporation pond (ARA-01 site) (DOE-ID 1992b). The third ROD was issued in January 1996 under OU 5-07 and focused on remediation of the SL-1 burial ground (ARA-06 site) and the identification of 10 no-action sites within OUs 5-01, 5-03, 5-04, and 5-11 (and an additional burial ground within WAG 6, OU 6-01, that is not summarized here) (INEL 1996). Although no additional effort was expended to remediate or assess these no-action sites individually, each was considered for cumulative effects in the comprehensive RI/FS for WAG 5. The fourth ROD, also known as the comprehensive ROD for WAG 5 (OU 5-12), was issued in January 2000 and describes the proposed remedial action for WAG 5 sites not covered by the previous RODs (DOE-ID 2000a).

Table 8-1. Contaminants of concern at Waste Area Group 5.

Site (Site Code)	COC	Remediation Goal
PBF Corrosive Waste Sump (PBF-08)	Cs-137 Chromium	30 pCi/g 800 mg/kg
PBF Evaporation Pond (PBF-10)	Cs-137 Chromium	30 pCi/g 800 mg/kg
SPERT-II Leach Pond (PBF-16)	Mercury	0.5 mg/kg
Contaminated Soil beneath PER-751 Pump House Floor Slab and Foundation (PBF-37)	Cs-137	23 pCi/g
ARA-I Chemical Evaporation Pond (ARA-01)	Arsenic Selenium Thallium	10 mg/kg 2.2 mg/kg 4.3 mg/kg
ARA-I Sanitary Waste System (ARA-02)	Cs-137 Ra-226 U-235 U-238 Aroclor-1242 Lead	8.5 pCi/g[a] 2.1 or 1.2 pCi/g[b] 6.2 pCi/g[a] 10.6 pCi/g[a] 1 mg/kg[c] 400 mg/kg
ARA-II Stationary Low-Power Reactor No. 1 Burial Ground (ARA-06)	Refer to Tables 8-2 and 8-3	Inhibit exposure to radioactive constituents.
ARA-III Radioactive Waste Leach Pond (ARA-12)	Ag-108m Copper Mercury Selenium	0.75 pCi/g 220 mg/kg 0.5 mg/kg 2.2 mg/kg
ARA-I Radionuclide Tank (ARA-16)	Cs-137	23 pCi/g

Table 8-1. (continued).

Site (Site Code)	COC	Remediation Goal
Radiologically Contaminated Surface Soils and Subsurface Structures Associated with ARA-I and ARA-II (ARA-23)	Cs-137	23 pCi/g
ARA-I Soil beneath the ARA-626 Hot Cells (ARA-25)	Cs-137	23 pCi/g
	Ra-226	2.1 or 1.2 pCi/g[b]
	Arsenic	5.8 mg/kg
	Lead	400 mg/kg
	Copper	220 mg/kg

a. The remediation goals for Cs-137, U-235, and U-238 are weighted averages based on relative risk contributions and 100 times the 1E-06 risk-based soil concentrations reported by Fromm (1996). The cumulative risk for Cs-137, U-235, and U-238 is 1E-04 at the remediation goal soil concentrations.

b. The remediation goal is the average INL Site background value for Ra-226 reported by Giles (1998), because the 1E-04 risk-based concentration derived from Fromm (1996), 0.55 pCi/g, is below the INL-average background concentration. A goal of 2.1 pCi/g will be used for comparison of sample results that may include interference from U-235. Otherwise, a goal of 1.2 pCi/g will be used.

c. The reference addresses PCB remediation waste for high-occupancy areas. Though the seepage pit sludge is not remediation waste, 1 mg/kg was identified as a protective remediation goal for the aroclor-1242 contained in the seepage pit sludge. A noncarcinogenic risk-based remediation goal could not be developed, because a reference dose for calculating a hazard quotient specific to aroclor-1242 is unavailable. The toxicity of aroclor-1242 was qualitatively assessed using the reference doses for aroclor-1254.

ARA = Auxiliary Reactor Area
COC = contaminant of concern
INL = Idaho National Laboratory
PBF = Power Burst Facility
PCB = polychlorinated biphenyl
SPERT = Special Power Excursion Reactor Test

Table 8-2. Surface soil concentrations for various contaminants of concern at SL-1.

Radionuclide	Concentration (pCi/g)	
	95% Upper Confidence Limit	INL Background[a]
Co-60	0.36	No data are available.
Cs-137	904	1.28
Eu-154	2.68	No data are available.
Sr-90	1370	0.76
Th-230 and/or U-234	2.7	1.88/1.95

a. The 95%/95% upper tolerance limit, grab sample background concentrations are from *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (Rood, Harris, and White 1995).

INL = Idaho National Laboratory

Table 8-3. Subsurface concentrations for various contaminants of concern at SL-1.

Radionuclide	Concentration (pCi/g)	
	July 1994	July 2094 (Anticipated)
Cs-137	2.29E+04	2.27E+03
Sr-90	2.15E+04	1.99E+03
Kr-85	6.91E+02	1.08E+00
Sm-151	5.20E+02	2.41E+02
Pm-147	2.62E+01	8.78E-11
Pu-241	1.96E+01	1.59E-01
Eu-154	1.84E+01	5.80E-03
Eu-155	1.24E+01	1.05E-05
Pu-239	1.04E+01	1.04E+01
Tc-99	6.85E+00	6.85E+00
Pu-238	6.72E+00	3.05E+00
Am-241	2.57E+00	2.76E+00
Pu-240	1.56E+00	I.55E+00
Zr-93	1.04E+00	1.04E+00

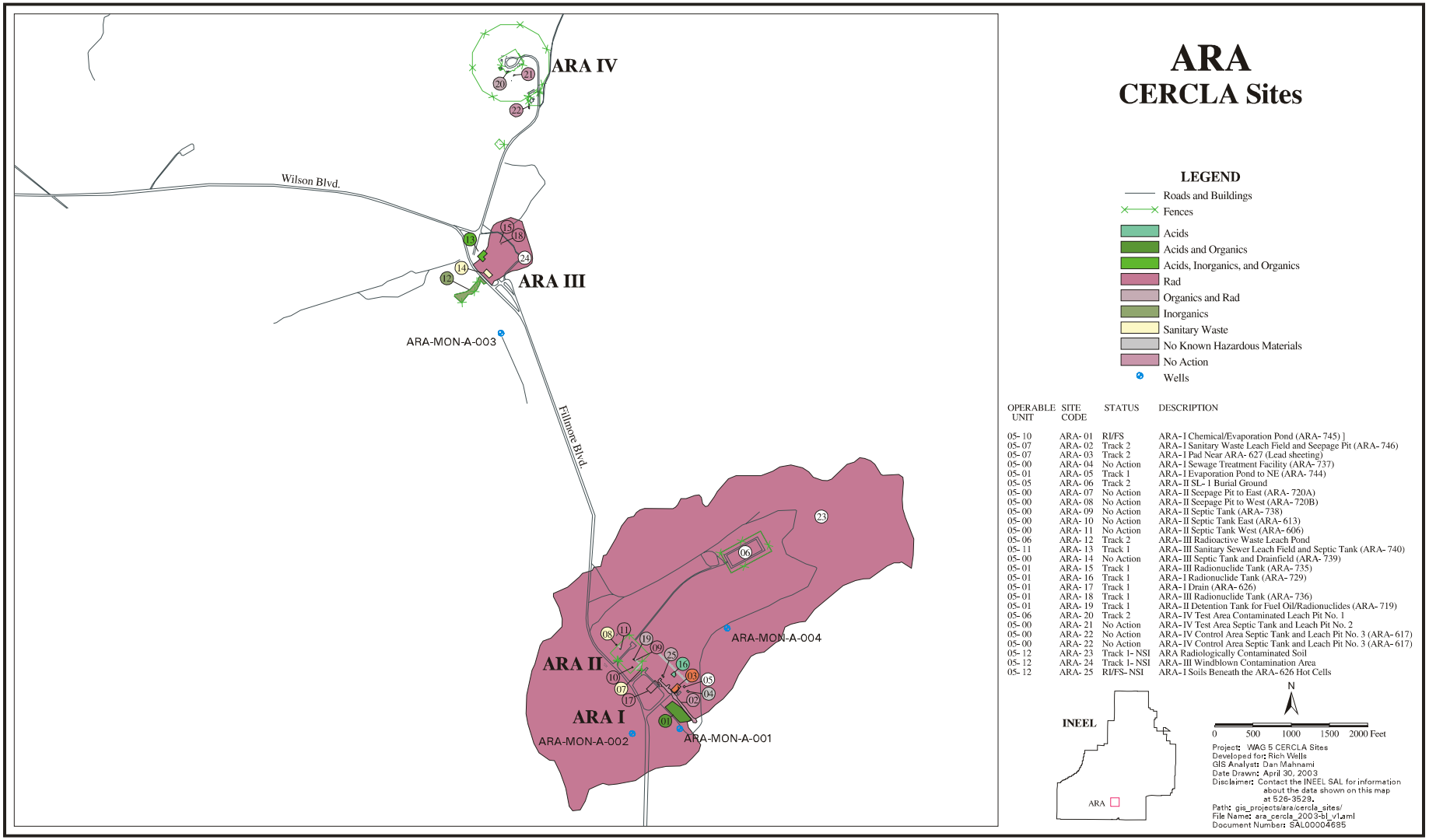
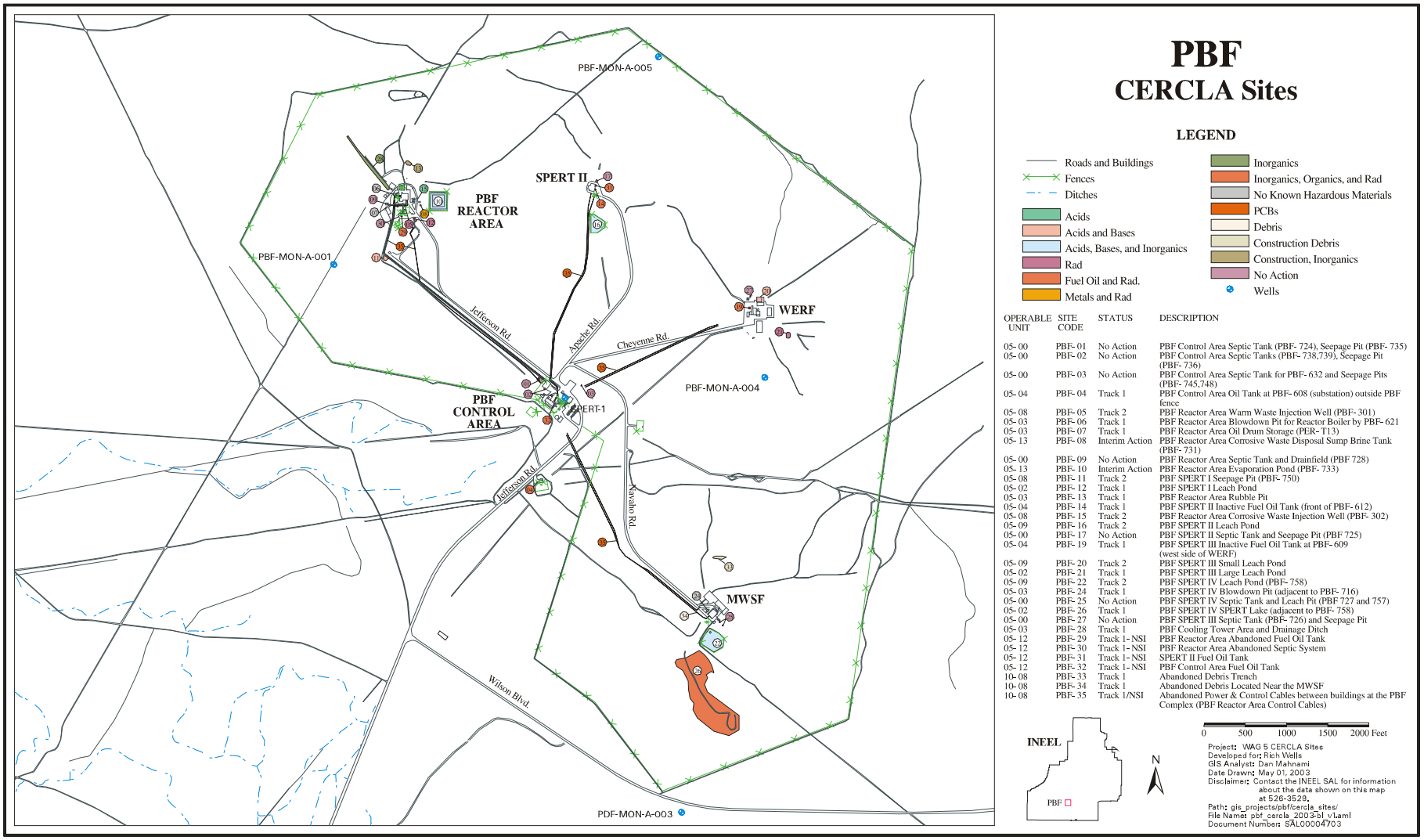


Figure 8-1. Auxiliary Reactor Area CERCLA sites.



OPERABLE UNIT	SITE CODE	STATUS	DESCRIPTION
05-00	PBF-01	No Action	PBF Control Area Septic Tank (PBF-724), Seepage Pit (PBF-735)
05-00	PBF-02	No Action	PBF Control Area Septic Tanks (PBF-738,739), Seepage Pit (PBF-736)
05-00	PBF-03	No Action	PBF Control Area Septic Tank for PBF-632 and Seepage Pits (PBF-745,748)
05-04	PBF-04	Track 1	PBF Control Area Oil Tank at PBF-608 (substation) outside PBF fence
05-08	PBF-05	Track 2	PBF Reactor Area Warm Waste Injection Well (PBF-301)
05-03	PBF-06	Track 1	PBF Reactor Area Blowdown Pit for Reactor Boiler by PBF-621
05-03	PBF-07	Track 1	PBF Reactor Area Oil Drum Storage (PER-T13)
05-13	PBF-08	Interim Action	PBF Reactor Area Corrosive Waste Disposal Sump Brine Tank (PBF-731)
05-00	PBF-09	No Action	PBF Reactor Area Septic Tank and Drainfield (PBF 728)
05-13	PBF-10	Interim Action	PBF Reactor Area Evaporation Pond (PBF-733)
05-08	PBF-11	Track 2	PBF SPERT I Seepage Pit (PBF-750)
05-02	PBF-12	Track 1	PBF SPERT I Leach Pond
05-03	PBF-13	Track 1	PBF Reactor Area Rubble Pit
05-04	PBF-14	Track 1	PBF SPERT II Inactive Fuel Oil Tank (front of PBF-612)
05-08	PBF-15	Track 2	PBF Reactor Area Corrosive Waste Injection Well (PBF-302)
05-09	PBF-16	Track 2	PBF SPERT II Leach Pond
05-00	PBF-17	No Action	PBF SPERT II Septic Tank and Seepage Pit (PBF 725)
05-04	PBF-19	Track 1	PBF SPERT III Inactive Fuel Oil Tank at PBF-609 (west side of WERF)
05-09	PBF-20	Track 2	PBF SPERT III Small Leach Pond
05-02	PBF-21	Track 1	PBF SPERT III Large Leach Pond
05-09	PBF-22	Track 2	PBF SPERT IV Leach Pond (PBF-758)
05-03	PBF-24	Track 1	PBF SPERT IV Blowdown Pit (adjacent to PBF-716)
05-00	PBF-25	No Action	PBF SPERT IV Septic Tank and Leach Pit (PBF 727 and 757)
05-02	PBF-26	Track 1	PBF SPERT IV SPERT Lake (adjacent to PBF-758)
05-00	PBF-27	No Action	PBF SPERT III Septic Tank (PBF-726) and Seepage Pit
05-03	PBF-28	Track 1	PBF Cooling Tower Area and Drainage Ditch
05-12	PBF-29	Track 1-NSI	PBF Reactor Area Abandoned Fuel Oil Tank
05-12	PBF-30	Track 1-NSI	PBF Reactor Area Abandoned Septic System
05-12	PBF-31	Track 1-NSI	SPERT II Fuel Oil Tank
05-12	PBF-32	Track 1-NSI	PBF Control Area Fuel Oil Tank
10-08	PBF-33	Track 1	Abandoned Debris Trench
10-08	PBF-34	Track 1	Abandoned Debris Located Near the MWSF
10-08	PBF-35	Track 1/NSI	Abandoned Power & Control Cables between buildings at the PBF Complex (PBF Reactor Area Control Cables)

Figure 8-2. Power Burst Facility CERCLA sites.

The *Record of Decision Power Burst Facility and Auxiliary Reactor Area, Operable Unit 5-12* (DOE-ID 2000a) evaluated 55 individual sites that were identified in the *Waste Area Group 5 Operable Unit 5-12 Comprehensive Remedial Investigation/Feasibility Study* (Holdren et al. 1999). Of the 55 sites, the OU 5-12 ROD (DOE-ID 2000a) provided information to support remedial actions for six sites at ARA (ARA-01, ARA-02, ARA-12, ARA-16, ARA-23, and ARA-25) and one at PBF (PBF-16) where contamination presented an unacceptable risk to human health and the environment. The OU 5-12 ROD also reviewed the no-action determination for the ARA-I chemical evaporation pond (ARA-01) and stated that remedial action was required. The OU 5-12 ROD also established that groundwater monitoring was to be conducted at WAG 5 until results of a five-year review warranted discontinuation of the monitoring. This monitoring resulted from a concern about elevated lead concentrations that had been detected in selected wells at the site.

As part of the OU 5-12 remedial action, a new site designated as PBF-37 was identified as requiring remediation. The PBF-37 site consists of contaminated soil beneath the floor slab and foundation of the Power Excursion Reactor (PER) -751 radioactive waste storage tank pump house. A New Site Identification Form was completed for this site in September 2004. It was anticipated that this contaminated soil site could be remediated in a manner similar to all other Phase II OU 5-12 contaminated soil (i.e., soil removal to either basalt or designated remedial action guidelines). As such, the agencies agreed to include the PBF-37 site under the OU 5-12 remedial action for contaminated soils. The site was remediated in the fall of 2004, with all residual sampling results returned by the winter of 2004/2005.

Institutional controls also were required for six of the seven remedial action sites—the exception being the PBF-16 site. No additional remediation activities were conducted for the remaining 48 sites in WAG 5, but the ROD did require institutional controls for nine of the 48 sites. A no-action decision was made for the remaining 39 sites, because they presented no unacceptable risks. Also included in the ROD are the institutional control requirements associated with both the residual PBF evaporation pond (PBF-10 site), which was remediated as part of the OU 5-13 interim ROD, and the residual SL-1 burial ground (ARA-06 site), which was remediated in accordance with the *Record of Decision: Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INEL 1996).

In addition, four previously identified inactive waste systems were closed during the OU 5-12 remediation activities as part of "best management" practices. These four sites were the ARA-07 site (the seepage pit east of ARA-II [ARA-720A]), the ARA-08 site (the seepage pit west of ARA-II [ARA-720B]), the ARA-13 site (the area around the ARA-III sanitary sewer distribution box and septic tank [ARA-740]), and the ARA-21 site (the ARA-IV test area septic tank and Leach Pit No. 2). Details of remedial actions for each of the remediation sites are discussed in the following subsections.

Table 8-4 provides a chronology of the major remedial action events associated with WAG 5.

Table 8-4. Chronology of Waste Area Group 5 events.

Event	Date
The SPERT-I reactor operations began.	1955
The ARA-I, ARA-II, and ARA-IV facilities were constructed.	1957
The SPERT-II reactor operations began.	1958
The ARA-III facility was constructed to house the Army Gas-Cooled Reactor Experiment.	1959
The SPERT-II reactor operations began.	1960
The SL-1 reactor accident occurred.	January 1961
The Army Gas-Cooled Reactor Experiment at ARA-III was deactivated.	1961
The SPERT-IV reactor operations began.	1961
The ARA-III facility was modified to support the Mobile Low-Power Reactor tests at ARA-IV.	1963
The SPERT-I reactor operations ceased.	1964
The SPERT-II reactor operations ceased, and the facility was converted for research purposes.	1964
The Army Reactor Program was phased out.	1965
Nuclear Effects Reactor operations began at ARA-III.	1967
The SPERT-III reactor operations ceased.	1968
ARA-III was modified to support other INL programs.	1969
Nuclear Effects Reactor operations ceased at ARA-III.	1970
The SPERT-IV reactor operations ceased.	1970
The PBF reactor construction was completed and operations began.	1972
The ARA-IV facility was shut down (some welding qualification work continued at the facility).	1975
The SPERT-IV reactor building D&D was completed.	1979
The SPERT-III reactor building D&D was completed.	1980
Waste Experimental Reduction Facility operations began at the former SPERT-III reactor location.	1982
The ARA-IV facility D&D was completed (explosives testing continued at the facility).	1985
The SPERT-I reactor was demolished.	1985
The PBF reactor was placed in standby mode.	1985
The SPERT-IV facility was modified, becoming the Mixed Waste Storage Facility.	1985
The ARA-II facility was shut down.	1986
The ARA-I facility was shut down.	1988

Table 8-4. (continued).

Event	Date
The ARA-III facility was shut down.	1989
The PBF ROD was issued for the corrosive waste sump and evaporation pond (OU 5-13)—an interim action decision.	September 1992
The ROD was issued for the ARA-I chemical evaporation pond (OU 5-10)—a no-action decision.	December 1992
The RD/RA Work Plan (INEL 1993) was completed for the PBF-08 corrosive waste sump and PBF-10 evaporation pond (OU 5-13).	November 1993
Mobilization for the OU 5-13 remedial action occurred.	November 1993
The first ESD (DOE-ID 1994a) was issued for the OU 5-13 interim action.	May 1994
The second ESD (DOE-ID 1994b) was issued for the OU 5-13 interim action.	December 1994
Final demobilization from the OU 5-13 remedial action occurred.	January 1995
The Remedial Action Report was issued for the PBF-08 corrosive waste sump and PBF-10 evaporation pond interim action (OU 5-13) (Parsons 1995).	March 1995
The RI/FS Report was issued for SL-1 (OU 5-05) and the BORAX-I (OU 6-01) burial grounds (INEL 1995).	March 1995
The ROD for SL-1 burial ground (OU 5-05), the BORAX-I burial ground (OU 6-01), and 10 no-action sites within WAG 5 (OUs 5-01, 5-03, 5-04, and 5-11) was issued (INEL 1996).	January 1996
Mobilization for the OU 5-05 remedial action occurred.	July 1996
Final demobilization from the OU 5-05 remedial action occurred.	April 1997
The Remedial Action Report for the SL-1 burial ground (OU 5-05) and BORAX-I (OU 6-01) burial ground remedial actions was completed (DOE-ID 1997).	October 1997
The ARA-II facility D&D was completed.	1997
The WAG 5, OU 5-12 Comprehensive RI/FS was issued (DOE-ID 1999).	January 1999
The ARA-III facility D&D was completed.	1999
The comprehensive ROD for PBF and ARA (OU 5-12) was completed (DOE-ID 2000a).	January 2000
Mobilization for the OU 5-12 remedial action, Phase I, occurred.	June 2000
Incinerator operations at the Waste Experimental Reduction Facility were shut down.	September 2000
The ARA-I facility D&D was completed.	2000
Revision 1 of the RD/RA Work Plan for Phase I of the WAG 5 comprehensive remedial action (OU 5-12) was completed (DOE-ID 2001).	June 2001
The EPA completed the initial five-year remedial action review of the SL-1 and BORAX-I burial grounds (OU 5-05 and OU 6-01).	August 2001
Final demobilization from the OU 5-12 remedial action, Phase I, occurred.	November 2001

Table 8-4. (continued).

Event	Date
The Remedial Action Report for Phase I of the WAG 5 comprehensive remedial action (OU 5-12) was issued (DOE-ID 2002).	January 2002
The RD/RA Work Plan for Phase II of the WAG 5 comprehensive remedial action (OU 5-12) was issued (DOE-ID 2003).	April 2003
Mobilization for the OU 5-12 remedial action, Phase II, occurred.	October 2003
The Waste Experimental Reduction Facility was closed.	2003
The mission of the Waste Experimental Reduction Facility was converted to the Large-Scale Development Facility.	2004
The Mixed Waste Storage Facility was closed, and its mission was converted to the Contraband Detection Facility.	2004
The mission of the Waste Engineering Development Facility was converted to the Special Programs Facility.	2004
Remedial action activities and post-remediation sampling activities were completed for Phase II of the WAG 5 comprehensive remedial action (OU 5-12).	September 2004

ARA = Auxiliary Reactor Area
BORAX = Boiling Water Reactor Experiment
D&D = decontamination and decommissioning
DOE-ID = U.S. Department of Energy Idaho Operations Office
EPA = U.S. Environmental Protection Agency
ESD = Explanation of Significant Differences
INEL = Idaho National Engineering Laboratory
INL = Idaho National Laboratory
OU = operable unit
PBF = Power Burst Facility
RD/RA = remedial design/remedial action
RI/FS = remedial investigation/feasibility study
ROD = Record of Decision
SL-1 = Stationary Low Power Reactor No. 1
SPERT = Special Power Excursion Reactor Test
WAG = waste area group

8.1 Remedial Actions

As previously stated, four RODs have been prepared for contaminated sites within WAG 5. Based on these RODs, remedial actions have been identified for 10 individual sites, and no further actions have been identified for nine additional sites. Details of the WAG 5 remedial actions are described in the following subsections.

8.1.1 Remedy Selection

Remedies were selected for the WAG 5 sites identified as posing unacceptable risk through the CERCLA remedy selection process described in the *Power Burst Facility Record of Decision: Power Burst Facility Corrosive Waste Sump and Evaporation Pond, Operable Unit 5-13, Waste Area Group 5* (DOE-ID 1992a), the *Record of Decision: Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INEL 1996), and the *Record of Decision Power Burst Facility and*

Auxiliary Reactor Area, Operable Unit 5-12 (DOE-ID 2000a). The following subsections briefly describe the selected WAG 5 remedial actions.

8.1.1.1 Corrosive Waste Sump (PBF-08 Site) and Evaporation Pond (PBF-10 Site). The selected remedial actions at the PBF corrosive waste sump and evaporation pond consisted of removing high contaminant concentrations in the evaporation pond, stabilizing contaminated material from the pond by grouting, disposing of waste, removing sludge and sediment in the corrosive waste sump, treating materials and sediment removed from the sump by grouting if feasible, and disposing of materials.

8.1.1.2 Sanitary Waste System (ARA-02 Site). The selected remedy for the sanitary waste system was removal, ex situ thermal treatment, and disposal. The activities required to implement the selected remediation alternative for this site included the following:

- Excavation and removal of the sludge and all components of the septic system
- Shipping of structural components of the system to an acceptable facility for disposal
- Thermal treatment of the sludge at an approved facility with appropriate disposal of the treated residual
- Additional sampling of the soil to be excavated, the sludge in the seepage pit, and the septic tanks, piping, and pumice blocks
- Dust control and environmental monitoring during active remediation.

8.1.1.3 ARA-II SL-1 Burial Ground (ARA-06 Site). The selected remedial action for the SL-1 burial ground included containment by capping with an engineered barrier of native materials, contouring and grading of the surrounding terrain, periodic aboveground radiological surveys, periodic inspection and maintenance, and implementation and maintenance of institutional controls. The major components of the selected remedy included the following:

- Containment by capping with an engineered barrier constructed primarily of native materials
- Contouring and grading of surrounding terrain to direct surface water run-off away from the cap
- Periodic aboveground radiological surveys after completion of the cap to assess the effectiveness of the remedial action
- Periodic inspection and maintenance after completion of the cap to ensure cap integrity and surface drainage away from the barrier
- Access restrictions consisting of fencing, posted signs, and permanent markers
- Restrictions limiting land use to industrial applications for at least 100 years following completion of the cap
- Review of the remedy no less than every 5 years until determined by the agencies to be unnecessary.

8.1.1.4 Radionuclide Tank (ARA-16 Site). Selected remedial actions at the radionuclide tank included removal and disposal of tank contents; removal, decontamination, and disposal of the tank and pipes; removal and disposal of the concrete and gravel around the tank; removal and disposal of contaminated soil; backfilling of excavated areas; and maintenance of existing institutional controls. Specifically, the remediation alternative consisted of the following:

- Removal of waste from the tank, transferring the waste to a high-integrity container (HIC) for storage, and dewatering the waste to the extent practicable (the separated liquid phase was stabilized and sent to the ICDF for disposal; the sludge will be treated concurrently with the V-Tanks waste, with residuals disposed of at the ICDF)

- Excavation of the tank and vault, with concrete encapsulation of the tank for disposal at the ICDF and disposal of the vault at the RWMC

- Excavation of soils with Cs-137 concentrations exceeding the remediation goal and disposal of these soils at the RWMC

- Excavation and concrete encapsulation of associated piping for disposal at the ICDF

- Appropriate sampling of the subject waste streams to demonstrate that the waste met the acceptance criteria for treatment or disposal

- Dust control and environmental monitoring during active remediation

- Restoration of the site after remediation.

8.1.1.5 Contaminated Soil Sites (ARA-01, ARA-12, ARA-23, ARA-25, PBF-16, and PBF-37 Sites). The following activities were chosen to remediate the six contaminated soil sites:

- Removal of soil using conventional earth-moving equipment (e.g., scrapers and backhoes)

- Real-time analyses before and during excavation to delineate the extent of contamination for removal (a combination of real-time analyses, field-screening methods, and soil sampling and laboratory analyses was used to verify that the remediation goals had been satisfied)

- Backfilling with uncontaminated soil or sloping of areas excavated to depths greater than 1 ft to promote drainage (all excavations were contoured to match the surrounding terrain and were revegetated)

- Characterization of contaminated soil and permanent disposal at the ICDF

- Maintenance of institutional controls consisting of signs, access controls, and land-use restrictions (post-remediation institutional control requirements will be maintained until discontinued based on the results of this or subsequent five-year reviews and concurrence of the agencies)

- Five-year reviews of remediated sites that have institutional controls.

Originally, the SPERT-II leach pond (PBF-16 site) was thought to be contaminated with unacceptable levels of mercury, based on the results of a single sample. Subsequent sampling of the soil at the pond demonstrated that the mercury concentrations were below the remedial action goal of 0.5 mg/kg. Therefore, the proposed remediation of PBF-16 was modified to no action.

8.1.1.6 Institutional Control Sites. As a result of the PBF and ARA ROD (DOE-ID 2000a) and the OU 5-12 remedial actions, a total of 13 sites have been identified as requiring institutional controls within WAG 5. Figure 8-3 shows the locations of the ARA institutional control sites, and Figure 8-4 shows the locations of institutional control sites at PBF. Brief descriptions of the institutional controls for each of these 13 sites are provided below.

PBF Reactor Area Evaporation Pond (PBF-733) (PBF-10 Site)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF SPERT-I Leach Pond (PBF-12 Site)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF Reactor 4 Area Rubble Pit (PBF-13 Site)—Control land use to prohibit potential exposure to friable asbestos. Augment the existing institutional controls with signs and maintenance of the existing cover. Periodic inspections also will be defined in the WAG 5 institutional controls plan (DOE-ID 2000b). Institutional controls will be maintained until discontinued based on the results of a five-year review. Recommendations for appropriate land-use restrictions will accompany any land transfer.

PBF SPERT-III Large Leach Pond (PBF-21 Site)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF SPERT-IV Leach Pond (PBF-758) (PBF-22 Site)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF SPERT-IV Lake (PBF-26 Site)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-I Lead Sheeting Pad near ARA-627 (ARA-03 Site)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-II Stationary Low-Power Reactor No. 1 Burial Ground (ARA-06 Site)—Maintain land-use controls to inhibit intrusion into the buried waste. Surface contamination will be addressed by the remediation of the ARA-23 site. Institutional controls will be maintained until discontinued based on the results of a five-year review. Recommendations for appropriate land-use restrictions will accompany any land transfer.

ARA-II Seepage Pit to the East (ARA-720A) (ARA-07 Site)—Restrict the site to industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-II Seepage Pit to the West (ARA-720B) (ARA-08 Site)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-II Radiologically Contaminated Surface Soils around ARA-I and ARA-II (ARA-23 Site)—Restrict the site to all but industrial land use until remediation is implemented as prescribed in the ROD. Land-use controls will not be required after remediation if all contaminated soil is removed to basalt or contaminant concentrations are comparable to local background values. Otherwise, institutional controls will be maintained until discontinued based on the results of a five-year review.

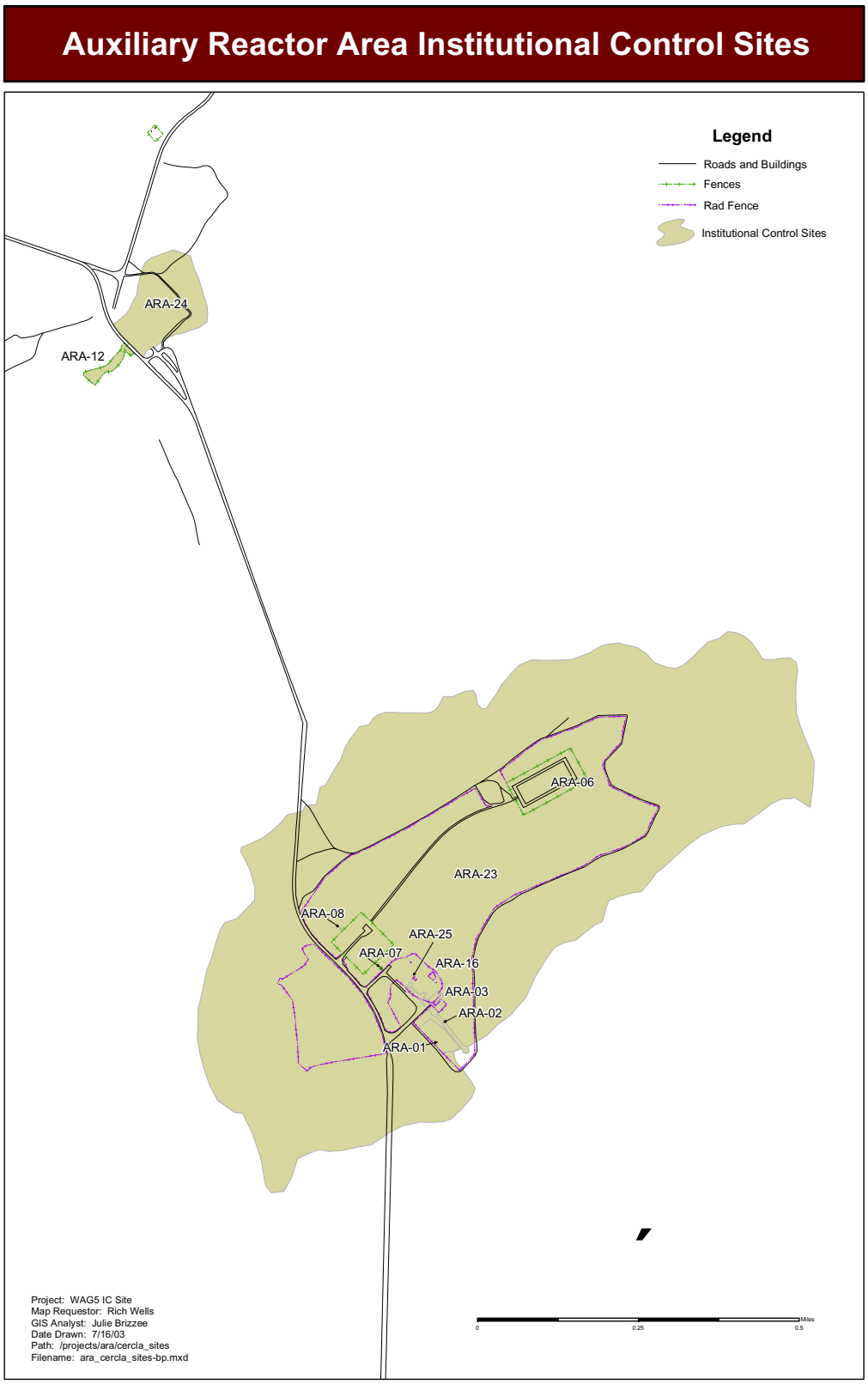


Figure 8-3. Auxiliary Reactor Area institutional control sites.

Figure 8-4. Power Burst Facility institutional control sites.

ARA-III Windblown Soil (ARA-24 Site)—Land use will be restricted to prohibit potential exposure to radiologically contaminated material. Institutional controls will be maintained until discontinued based on the results of a five-year review. Recommendations for appropriate land-use restrictions will accompany any land transfer.

ARA-I Soils beneath the ARA-626 Hot Cells (ARA-25 Site)—Restrict the site to all but industrial land use until remediation is implemented as prescribed in the ROD. Land-use controls will not be required after remediation if all contaminated soil is removed to basalt or contaminant concentrations are comparable to local background values. Otherwise, institutional controls will be maintained until discontinued based on the results of a five-year review.

Before remedial action activities, a total of 15 institutional control sites had been identified. The initially identified sites included ARA-01, ARA-02, ARA-12, and ARA-16, but did not include ARA-07 and ARA-08. The reason for eliminating ARA-01, ARA-02, ARA-12, and ARA-16 from institutional controls was that remediation of the sites reduced contamination below levels required for free release.

The institutional control sites that were added (ARA-07 and ARA-08) came about as part of additional remedial actions aimed at closing certain sites as part of best management practices. A total of four of theses sites were identified during Phase I remediation activities. These sites included ARA-07 and ARA-08 as well as ARA-13 and ARA-21. After remediation of each of these sites, their residual surfaces were evaluated to ascertain which of the sites needed institutional controls. Based on the review, ARA-07 and ARA-08 were identified as requiring institutional controls.

Table 8-5 provides a current list of the institutionally controlled sites at WAG 5, identifies the COCs and the concentration for each, the release criteria, and the expected release date.

Table 8-5. Waste Area Group 5 institutionally controlled sites.

Site	COC	Concentration	Analysis Date	Release Criteria	Release Date
ARA-03	Cs-137	5.00 pCi/g (95% Student's t UCL)	September 27, 1994	2.4 pCi/g	January 2036
ARA-06	Cs-137 Sr-90	22,900 pCi/g (maximum) 21,500 pCi/g (maximum)	July 1994	2.4 pCi/g 2,100 pCi/g	July 2394
ARA-07	Cs-137	17.6 pCi/g (maximum)	June 1991	2.4 pCi/g	June 2078
ARA-08	Cs-137	11.6 pCi/g (maximum)	June 1991	2.4 pCi/g	December 2059
ARA-23	Cs-137	83.8 pCi/g[a] (95% UCL)	September 2004	2.4 pCi/g	November 2158
ARA-24	Cs-137	<5 pCi/g (maximum)	September 1997	2.4 pCi/g	August 2029
ARA-25	Cs-137 Ra-226 Arsenic Lead Copper	398 pCi/g (maximum) 26.3 pCi/g (maximum) 36.0 mg/kg (maximum) 1,266 mg/kg (maximum) 201 mg/kg (maximum)	September 2001	2.4 pCi/g 0.52 pCi/g 5.8 mg/kg 400 mg/kg 220 mg/kg	Indefinite
PBF-10	Cs-137	15.8 pCi/g (95% Student's t UCL)	August 18, 1994	2.4 pCi/g	August 2076
PBF-12	Cs-137	16.37 pCi/g (95% approximate gamma UCL)	December 1984	2.4 pCi/g	August 2068
PBF-13	Asbestos	NA	NA	NA	Indefinite

Table 8-5. (continued).

Site	COC	Concentration	Analysis Date	Release Criteria	Release Date
PBF-21	Cs-137	18.4 pCi/g (99% Chebyshev UCL)	December 1982	2.4 pCi/g	September 2071
PBF-22	Cs-137	4.42 pCi/g (99% Chebyshev UCL)	December 1988	2.4 pCi/g	August 2015
PBF-26	Cs-137	4.67 pCi/g (95% Student's t UCL)	December 1985	2.4 pCi/g	August 2012

a. This concentration represents the maximum 95% UCL for one of five zones defined for ARA-23. The 95% UCL concentrations for the other four zones range from 9.5 to 22.3 pCi/g.

ARA = Auxiliary Reactor Area
COC = contaminant of concern
NA = not applicable
PBF = Power Burst Facility
UCL = upper confidence limit

8.1.2 Remedial Action Objectives

The RAOs for the WAG 5 sites were developed in accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," and EPA guidance. The RAOs result from risk assessments and are specific to the COCs and exposure pathways developed in the RODs for OUs 5-05, 5-13, and 5-12.

The RAOs for the corrosive waste sump and the evaporation pond at PBF are established in the OU 5-13 ROD (DOE-ID 1992a), and RAOs for the SL-1 burial ground site were established in the OU 5-05 ROD (INEL 1996). The RAOs for the sanitary waste system, the radionuclide tank, and the contaminated soil sites are presented in the ROD for OU 5-12 (DOE-ID 2000a). Detailed RAOs for each of the sites are presented in the following subsections.

8.1.2.1 Corrosive Waste Sump (PBF-08 Site) and Evaporation Pond (PBF-10 Site).

Cleanup goals for the PBF waste sump and evaporation pond sediments were developed based on a site-specific, residential-use scenario for a population that begins residing at the site in 100 years. This scenario results in the calculation of a conservative cleanup level protective of current occupational and future residential populations at PBF. The cleanup goal for chromium was 800 mg/kg. This level was established using equations from the *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)* (EPA 1989) and site-specific exposure parameters for the residential use scenario. As established in the OU 5-13 ROD (DOE-ID 1992a), the cleanup goal for Cs-137 in 1992 was 30 pCi/g and corresponded to a future excess cancer risk (100 years in the future) of 5×10^{-5}. Both cleanup levels were calculated using EPA-approved methods.

8.1.2.2 Sanitary Waste System (ARA-02 Site).

The RAOs for the sanitary waste system applied only to the ARA-02 seepage pit sludge, because all of the COCs at the site were contained within the sludge. As a result, the RAOs developed to protect human health included the following:

- Inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 for current and future workers and future residents
- Inhibit dermal absorption of COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 or a hazard index of 2 or greater for current and future workers and future residents.

8.1.2.3 ARA-II SL-1 Burial Ground (ARA-06 Site). Results of the remedial investigation and baseline risk assessment indicated that exposure to penetrating radiation from contaminated soils and material within the burial ground presented the most significant future risk to human health. Therefore, the primary RAOs and the focus of the remedial action alternative development were to inhibit exposure to radioactive materials. The RAOs established to protect human health included the following:

- Inhibit exposure to radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06)
- Inhibit ingestion of radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06)
- Inhibit inhalation of suspended radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06)
- Inhibit degradation of the burial grounds that could result in exposure of buried waste or migration of contaminants to the surface that would pose a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).

The RAO for protection of the environment focuses on preservation of the local ecology by inhibiting the potential for contaminant migration. The RAO established for protection of the environment is to inhibit adverse effects to resident species from exposure to contaminants at the burial ground.

As a result of these risks, a containment strategy was selected as the most appropriate remedy for the SL-1 burial ground.

8.1.2.4 Radionuclide Tank (ARA-16). Remediation objectives, based on the risks discussed in the OU 5-12 ROD (DOE-ID 2000a), were developed for the soil at the ARA-16 radionuclide tank. A risk of 1E-04 was posed to human health primarily by external exposure to ionizing radiation from Cs-137. In addition, remediation was applied to address the principal threat waste contained in the tank.

Because a release to the environment had not occurred, the contents of the radionuclide tank were not quantitatively evaluated in the remedial investigation/baseline risk assessment. Therefore, the risk assessment was limited to evaluating the soil outside of the tank. Cs-137 was the only COC identified for the ARA-16 site based on human health risks. The total estimated risk for the 100-year future residential scenario for the soil around the tank was 1E-04 (1 in 10,000) from Cs-137. The noncarcinogenic hazard quotient for residential exposure was less than 1. The total estimated risk for all pathways for the current occupational scenario was 3E-04 with a hazard index for the current occupational exposure of less than 1. The total estimated risk for all pathways for the 100-year occupational scenario was 1E-04 (1 in 10,000) with the primary contributor being Cs-137. The noncarcinogenic hazard index for the future occupational exposure was less than 1.

The human health threat posed by the radioactively contaminated soil and gravel in and around the ARA-16 tank vault is external exposure to ionizing radiation. No unacceptable ecological risk was associated with this site. The RAO developed for the soil and gravel was to inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 for current and future workers and for future residents. To meet this goal, a remediation goal of 23 pCi/g for Cs-137 was established. In addition, remediation was applied to address the principal threat waste contained in the tank.

Though no releases occurred from the ARA-16 tank and the tank was not leaking, the tank contents were identified as principal threat waste and could have posed an unacceptable risk if released to the environment. Therefore, an additional RAO was developed to prevent release of the tank contents and preclude human and ecological exposures to the ARA-16 tank contents.

8.1.2.5 Contaminated Soil Sites (ARA-01, ARA-12, ARA-23, ARA-25, and PBF-37 Sites).

A human health risk of 1E-04 at the contaminated soil sites was posed primarily by external exposure to ionizing radiation. The radioactive COCs were Ag-108m, Cs-137, and Ra-226. Dermal adsorption of arsenic and ingestion of Ra-226, arsenic, and lead posed secondary human health risks. Ecological hazard quotients greater than 10 were from exposure to selenium, thallium, copper, mercury, and lead in the soil.

The following RAOs were developed for the contaminated soil sites to protect human health and the environment:

- Inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 for current and future workers and future residents

- Inhibit dermal adsorption of COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 or a hazard index of 2 or greater for current and future workers and future residents

- Inhibit ecological receptor exposures to contaminated soil with concentrations of contaminants greater than or equal to 10 times background values and that result in a hazard quotient greater than or equal to 10.

Remediation goals were established to meet these RAOs. Remediation goals can be satisfied by either cleaning up to the identified contaminant concentration or by removing all soil down to the basalt interface. Removing soil down to basalt will be protective, because surface exposure pathways will be eliminated. The *Waste Area Group 5 Operable Unit 5-12 Comprehensive Remedial Investigation/Feasibility Study* (DOE-ID 1999) showed that groundwater exposure pathways pose a cumulative risk of less than 1E-04 and a hazard index of less than 1 for the baseline no-action alternative. Removal of contaminated soil further reduces the potential groundwater risk. Therefore, remediation to retrieve residual contamination that might have migrated into the fractured basalt would not be justified.

8.1.3 Remedy Implementation

8.1.3.1 Corrosive Waste Sump (PBF-08 Site) and Evaporation Pond (PBF-10 Site).

The OU 5-13 interim action was performed in two phases. The first phase consisted of excavation of the evaporation pond sediments, removal and replacement of the corrosive waste sump discharge pipe, and initial remediation activities for the sump. The second phase consisted of the final sump remediation activities. Details of the remediation are documented in the *Final Remedial Action Report: Power Burst Facility (PBF)-08 Corrosive Waste Sump and PBF-10 Evaporation Pond Interim Action, Operable Unit 5-13* (Parsons 1995).

Major components of the interim remedial action were as follows:

- Installation of engineering barriers to control dust migration

- Installation of a modular tank to receive discharges that could have occurred during the interim action due to an emergency situation and to be used for future discharges in lieu of the evaporation pond

- Excavation and placement (in low-level waste containers) of residual sludge and sediments from the corrosive waste sump to eliminate future contamination to the tank during discharge events, which was followed by decontamination of the sump interior

- Removal and placement (in low-level waste containers) of the discharge pipe from the corrosive waste sump to the evaporation pond

- Installation of new discharge piping from the corrosive waste sump to the modular tank

- Excavation and placement (in low-level waste containers) of 170 yd^3 of sediments from the evaporation pond using shovels and a skid-steer, front-end loader to remove from the evaporation pond contaminated sediments with chromium concentrations greater than 800 mg/kg and/or Cs-137 concentrations greater than 30 pCi/g

- Verification sampling beneath the existing liner to ensure that remaining concentrations of chromium and Cs-137 were below the cleanup levels

- Transport of filled low-level waste containers to the RWMC for disposal.

The OU 5-13 interim remedial action was initiated in 1993 and completed in 1994. During interim actions, changes made to the proposed remedial action were sufficient to require two ESDs. The first ESD (DOE-ID 1994a), issued in May 1994, increased the estimated amount of evaporation pond sediments requiring excavation from 100 yd^3 to 170 yd^3 while containing the sludge and sediments instead of stabilizing them, because the ungrouted sediments were found to meet the waste acceptance criteria for disposal at the RWMC. The second ESD (DOE-ID 1994b), issued in December 1994, found that the waste in the corrosive waste sump was characteristically toxic for chromium and would have to be stabilized in a more leach-resistant manner than previously estimated, increasing costs by more than 50%.

Initial remediation activities involved flushing the interior walls of the sump. First, a high-pressure sprayer was used to flush the walls of the sump and increase liquid volume, and then sump pumps were used to pump the residual liquid and sprayer rinsate to the evaporation pond. The initial flush pumped all of the sump water to the evaporation pond without suspending the sludge and sediment at the bottom of the sump. After flushing, the sump discharge line was removed, cut into 1-ft sections, and disposed of at the CFA bulky waste landfill (since no radioactive contamination was detected). New underground piping was then installed from the large modular tank to the sump. The modular tank used was 63 ft in diameter, and 5.5 ft high, with a capacity of 124,000 gal. The cylindrical tank was fabricated with metal sidewalls, two interior Hypalon liners, and a drainage monitoring system between the liners.

The subsequent step in the OU 5-13 remediation was to excavate the evaporation pond sediments. The evaporation pond was divided into 49 grids, each having approximate dimensions of 20 × 20 ft. Each grid was surveyed to ascertain those that needed to be excavated. Based on that survey, 21 of the 49 grids were marked for excavation. Laborers then used square-pointed shovels (initially) and a skid loader to excavate the contaminated soils from each of the 21 grids. Water sprays were used to prevent fugitive dust generation during excavation.

After evaporation pond excavation, remediation activities returned to the corrosive sump pump. The residual sludge and sediment from the bottom of the sump were removed using slurry pumps and a mobile filter press. The diatomaceous earth served as the pre-coat material for the filter plates. Squeegees were used to force the sludge particles to the slurry pump because of an inability to suspend the sludge using air sparging equipment. The conveyed sludge was then pumped to the filter press, where the sludge was retained on the filter plates while the effluent was circulated back into the sump. After filling the

filter plates with sludge, the sludge was dewatered, and the dry filter cake was scraped off and placed in interim storage at PBF. A high-pressure wash was used to remove surface contamination from the interior of the sump. The rinse water was processed through the filter press and then discharged in the modular evaporation tank.

After sludge removal, a TCLP analysis of the dewatered sludge found that it was characteristically toxic for trivalent chromium. The sludge was removed from storage at PBF, repackaged, and transported to the Mixed Waste Storage Facility, where the sludge was managed in accordance with the requirements of that facility's RCRA Part A permit.

8.1.3.2 Contaminated Soil beneath PER-751 Pump House Floor Slab and Foundation (PBF-37 Site). Site preparation for PBF-37 included establishing work control areas and controlled access points. Before sampling the soil, workers removed the soil cover that had been put in place after demolition and removal of the PER-751 tank and pump house. A front-end loader was used to scrape the soil cover into a pile. This facilitated sampling of the contaminated area. Before actual soil removal, the underlying tarps were removed. A backhoe was staged at the task site for removal of the contaminated soil. Soft-sided sacks were obtained to use as containers for the soil that was removed.

The extent of the site remediation was based on the original radiological survey of the posted soil contamination area. The controlled area measured roughly 20 ft wide and 40 ft long. A more defined area for purposes of soil removal was based on an in situ gamma survey that was conducted after soil samples were collected and by using hand-held survey instruments. In accordance with this survey, an 8- × 8-ft area found to have the highest level of contamination (based on the in situ gamma survey) was delineated in the southwestern quadrant of the site. To ensure optimum contamination removal, this area was excavated to a depth of 2 ft using a backhoe. Soil in the remaining contaminated soil area was excavated to a depth of 1 ft. A large concrete pier that supported the south tank saddle was encountered during excavation.

Excavated soil was placed in 12 soft-sided bags. These bags were loaded onto trailers and transferred to a registered CERCLA storage area located at the PBF Control Area. The storage area will be inspected weekly by a Waste Generator Services facility representative.

8.1.3.3 ARA-I Chemical Evaporation Pond (ARA-01 Site). The chemical evaporation pond is a shallow, unlined surface impoundment roughly 100 × 300 ft that was used to dispose of laboratory wastewater from the ARA-I Shop and Maintenance Building (ARA-627). Located southeast of ARA-I, the pond was constructed in 1970 by excavating soil to create a shallow topographic depression. Basalt outcrops are present within and immediately adjacent to the pond. The subsurface immediately beneath the pond consists of fracture and rubble zones. No interbed was found within the first 118 ft of the surface.

Contaminated soil was excavated from the pond in accordance with the requirements delineated in the *Record of Decision Power Burst Facility and Auxiliary Reactor Area, Operable Unit 5-12* (DOE-ID 2000a). This was followed by in situ field-screening measurements and confirmation sample analysis of the residual soil surface.

8.1.3.4 ARA-I Sanitary Waste System (ARA-02 Site). The septic system serviced the ARA-I facility from 1960 until 1988. The ARA-02 site was defined as the entire septic system, including the three tanks (one septic tank, one settling tank, and one chlorine contact tank), a seepage pit, three manholes, and all associated piping leading from source buildings (both 4- and 8-in. diameter) as well as any contiguous soil contaminated from system materials. The septic system serviced ARA-I

Buildings 626, 627, and 628 and Office Trailers 1 and 2 outside of the ARA-I facility fence. The vertical extent of the site was defined by the depth to the soil/basalt interface.

At the ARA-02 site, the entire septic system was removed in accordance with the requirements of the *Record of Decision Power Burst Facility and Auxiliary Reactor Area, Operable Unit 5-12* (DOE-ID 2000a). The seepage pit sludge was removed and disposed of, thus mitigating the human health risk associated with this site.

8.1.3.5 ARA-II SL-1 Burial Ground (ARA-06 Site). Remediation of the SL-1 burial ground was performed in 1996 and 1997. Details of the SL-1 burial ground remedial action are contained in the *Remedial Action Report OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling Water Reactor Experimental-I Burial Grounds Engineered Barriers* (DOE-ID 1997).

The SL-1 contaminated-soil area was initially excavated to a depth of 6 in. using two front-end loaders. This was followed by the excavation of 1,527 yd^3 of contaminated soil in certain designated "hot spots." The 2,407 yd^3 of excavated contaminated soil was then transported, spread, and compacted over a 530- × 40-ft soil consolidation area between Trench 1 and Pit 2 of the SL-1 burial ground. This was followed by the addition and compaction of 9.9 yd^3 of investigation-derived waste into the soil consolidation area. A 22-in.-thick biotic barrier consisting of pea gravel and cobble was then placed over the soil consolidation area, followed by a human intrusion barrier of large angular basalt boulders. This was followed by the placement of fences, gates, and four granite monuments at the SL-1 site. After construction of the cap, the area around the cap was recontoured and reseeded. Institutional controls over the SL-1 burial ground were established in the OU 5-12 ROD (DOE-ID 2000a).

8.1.3.6 Radioactive Waste Leach Pond (ARA-12 Site). The radioactive waste leach pond was an unlined surface impoundment with approximate dimensions of 150 × 370 ft. The pond was constructed in a natural depression west of ARA-III to dispose of low-level liquid waste from reactor research operations. Liquid radioactive waste was stored temporarily in tanks and then transferred to the leach pond via an underground pipe. A second separate discharge line originated at an uncontaminated water storage tank. The pond also received facility run-off through a culvert. The ARA-III facility was active from about 1959 to 1965. From 1966 to 1987, activities at ARA-III were limited to component and instrumentation testing, instrumentation development and fabrication, and chemical research. Waste associated with these activities was not disposed of in the leach pond, and the only discharges to the pond during this period were from the water storage tank and facility run-off. The facility was shut down in 1987, leaving the pond dry except during spring run-off and heavy precipitation. In 1991, the culvert was plugged in preparation for D&D operations at ARA-III. In 1993, the tanks and waste lines to the leach pond were removed. Contaminated soil from the ARA-12 site was excavated in accordance with the requirements outlined in the OU 5-12 ROD (DOE-ID 2000).

8.1.3.7 ARA-I Radionuclide Tank (ARA-16 Site). The radionuclide tank was a 1,000-gal, stainless-steel underground tank that rested on a 6-in. gravel bed inside an open-topped concrete vault. The tank was 12 ft long and approximately 4 ft in diameter. The tank was connected to the ARA-626 and ARA-627 buildings within the ARA-I facility via stainless-steel piping. The tank had been partially excavated in the past for sampling; therefore, the depth of the fill material varied from the original design.

The tank had several piping connections, along with an internal pump and a manway cover. During initial remedial action activities, the pump and all external piping were removed from the tank. Connective piping to the tank was then cut and capped to isolate the tank. After the tank was isolated, approximately 317 gal of waste was removed from the tank and placed into a 400-gal HIC. The tank was rinsed, and the rinsate was also pumped to the HIC. The HIC allowed for the separation of the sludge from the liquid phase by pumping the liquid through a filtered media. The liquid phase was passed

through a carbon filter (to remove trace organic contamination) and solidified in 55-gal lined steel drums using a sodium polyacrylate monopolymer (i.e., Stergo). The slurry left in the HIC consisted of approximately 4.5 gal of sludge and 75.5 gal of supernatant. The slurry was a Type B radioactive waste that was transuranic and listed for both 1,1,1-TCA (F001) and toluene (F005).

The HIC that contained the concentrated waste was shielded and initially placed in storage at ARA-I awaiting eventual treatment as part of the OU 1-10 V-Tank waste treatment, which was scheduled for early 2005. The HIC has subsequently been shipped to TAN, where the waste awaits treatment. Pumping the waste out of the tank was followed by removal and disposal of both the tank (along with all associated piping) and the concrete vault surrounding the tank. Both removal actions were performed in accordance with the requirements of the OU 5-12 ROD (DOE-ID 2000a). Excavation proceeded to the basalt layer in some locations.

8.1.3.8 Radiologically Contaminated Surface Soil and Subsurface Structures associated with ARA-I and ARA-II (ARA-23 Site). The ARA-23 site is a 240-acre, windblown-contamination area that includes both residual subsurface structures from ARA-I and ARA-II and the areas surrounding ARA-I and ARA-II. Of the 240 acres, 42 acres exceeded risk-based concentrations and required remediation. The site also contained subsurface structures remaining after D&D activities within ARA-I and ARA-II. The radioactive contamination in the windblown soil was primarily due to contamination released from the 1961 SL-1 accident and its subsequent cleanup. However, minor amounts of contamination might have been added by other ARA operations. Over time, winds dispersed the contamination over an area of roughly 240 acres, but most of this windblown contamination is significantly less than risk-based remediation goals. The long axis of the roughly oval-shaped site is consistent with the generally southwest-to-northeast winds common at the INL Site.

The contaminated soil was removed from the ARA-23 site in accordance with the requirements delineated in the OU 5-12 ROD (DOE-ID 2000a). Soil contaminated with Cs-137 was removed and disposed of in a manner that mitigated the human health risk associated with this site. Excavation activities in 2003 were concentrated in the soil-contamination area next to Fillmore Boulevard at ARA-I and the area between the fence outside of the ARA-II facility and the windblown area. In 2004, excavation consisted of the windblown contamination area, the contaminated soil area near the haul road, the area near the SL-1 burial ground, the turnaround area, areas on top of the SL-1 burial ground, the area north of ARA-II, the washdown area across Fillmore Boulevard, and the bermed area next to ARA-I. In general, excavation was done using 1- to 6-in. excavation cuts over the entire contaminated soil area, followed by spot excavations in the more contaminated soil areas. In addition, the fence surrounding the ARA-II facility was removed and disposed of at the ICDF in 2004.

8.1.3.9 ARA-I Soil beneath the ARA-626 Hot Cells (ARA-25 Site). The ARA-25 site comprised contaminated soil that was discovered beneath the ARA-626 hot cells during D&D activities at the ARA-I facility in 1998. The contamination was found near the hot cell floor drains. The contaminated area immediately around the drains measured approximately 8 × 12 ft. However, other isolated hot spots beneath the building also were discovered. Therefore, a cumulative size of 16 × 24 ft was estimated for the site. The ARA-I hot cells were constructed in 1959 and used until the facility was shut down in 1988. Stainless-steel piping connected the floor drains to the ARA-729 radionuclide tank (ARA-16 site). The pipes were included in the remediation of the ARA-16 site and were not a component of the ARA-25 site.

The contaminated soils at the ARA-25 site were removed in accordance with the requirements of the OU 5-12 ROD (DOE-ID 2000a). The hot cell foundation was initially removed to allow for excavation of the underlying and immediately surrounding soil. The contaminated soil area was then removed to the basalt sublayer.

8.1.3.10 Inactive Waste System Sites. As previously stated, four inactive waste system sites (ARA-07, ARA-08, ARA-13, and ARA-21) were removed or abandoned in accordance with established regulatory standards. The following subsections discuss the actions taken at each of those four sites.

ARA-II Seepage Pit to the East (ARA-720A) (ARA-07 Site)—The ARA-07 site was one of the no-action sites closed as part of Phase I cleanup activities during remediation of OU 5-12. The pit was constructed of 8- × 8- × 16-in. pumice blocks laid on their sides in the shape of a circle. The seepage pit had a diameter of 13 ft and a depth of 10 ft. The top two courses of pumice blocks were set in mortar. As-Built Drawing No. 102832 shows the first course of blocks set on bedrock and leveled with concrete. The pit had a gravel base and contained approximately 6 to 12 in. of sludge. The top of the pit extended above the ground and was covered by a wooden roof with lifting rings and a 2- × 2-ft square access port. A 4-ft-high, chain-link fence surrounded the entire structure.

The seepage pit was just outside of the ARA-II facility fence and was the terminus of two septic tanks serving the Administration Building (Building 613) and the Technical Support Building (Building 602). The seepage pit was also thought to be the terminating point for an underground waste detention tank (ARA-719), which was removed during D&D activities (INEEL 1999). The system was used from approximately 1959 to 1986. To close the pit, the roof structure and top two courses of cement blocks were removed and disposed of. The seepage pit was then filled with earthen material and abandoned.

ARA-II Seepage Pit to the West (ARA-720B) (ARA-08 Site)—The ARA-08 site was another no-action site that was closed as part of Phase I cleanup activities during remediation of OU 5-12. The seepage pit was inactive and had a diameter of 13 ft and a depth of 10 ft. The pit was constructed using the same pumice blocks and layout as was used at the ARA-07 site. The pit contained approximately 18 to 24 in. of sludge. Three separate concrete slabs measuring approximately 3 × 10 ft capped the pit. The concrete slabs were covered by approximately 3 ft of soil.

The seepage pit was just outside the ARA-II facility fence and received waste from the Administrative and Technical Support Building (Building 606). The system was used from approximately 1959 to 1986. To close the site, the concrete slab covering the pit was removed and disposed of. The pit was then filled with earthen material and abandoned.

ARA-III Sanitary Sewer Leach Field (ARA-740) (ARA-13 Site)—The ARA-13 site was the third no-action site that was closed as part of Phase I cleanup activities during remediation of OU 5-12. The ARA-13 site consisted of a manhole, a septic tank system, a distribution box, and a leach field. Sanitary waste was disposed of in the system from 1969 to 1980. In addition to sanitary waste, small quantities of laboratory waste were diverted to this system between 1980 and 1983.

As part of best management practices, an estimated 2,300 gal of liquid was pumped out of the septic tank system and disposed of in the CFA sanitary sewer system. The septic tank and distribution box were then excavated to allow access to the sludge in the bottoms of the components. Upon excavation, the septic tank system was found to be three separate tanks in series. The top half of each tank was removed, and dry cement and Aquaset were mixed into the residual sludge in each tank to remove free liquids. The sludge from the septic tanks was then removed, placed into soft-sided containers, and disposed of at the RWMC. Sludge from the distribution box was removed, mixed with dry cement (to solidify free liquids), and disposed of at Envirocare. The tops of each septic tank were surveyed, found to be free of radioactive contamination, and shipped to the CFA landfill for disposal. The ARA-13 system components remaining in the ground were then decontaminated, visually inspected, and surveyed for radiological contamination. No radiological contamination was detected. Holes were then made in the bottom of each component, and each component and the excavation were filled with earthen material before being disposed of.

ARA-IV Septic Tank and Seepage Pit #2 (ARA-21 Site)—The ARA-21 site was the fourth no-action site that was closed as part of Phase I cleanup activities during remediation of OU 5-12. The ARA-21 site consisted of a 1,000-gal underground septic tank, an estimated 250- to 500-gal chlorine contact tank, and a seepage pit that received sanitary waste from the ARA-IV Test Area Building (ARA-616). The system was used from approximately 1957 to 1970. During D&D operations in 1987, the piping was cut 10 ft from the building, and the tanks and leach pit were covered with 6 ft of soil. For purposes of best-management practices, the liquid waste was removed from the septic tanks and disposed of at the CFA sanitary sewer system.

8.2 Data Evaluation

This data evaluation section includes a summary of annual site inspections, compilation and evaluation of data collected during soil excavation activities, and compilation and examination of groundwater data collected during the 5 years covered by this review.

8.2.1 Site Inspections

Annual site inspections included visual inspection of the engineered rip-rap and a radiological survey around the perimeter of the ARA-II SL-1 burial ground (ARA-06 site) to determine the extent, if any, of contaminant migration.

Visual site inspections showed that the riprap cover is functioning as designed and showed no signs of subsidence of animal intrusion. In addition, the results from the annual radiological surveys indicate that the remedy is functioning as intended, and no unexplained radiological anomalies have appeared.

Site inspections at institutionally controlled sites were conducted annually at ARA-03, ARA-06, ARA-07, ARA-08, ARA-23, ARA-24, ARA-25, PBF-10, PBF-12, PBF-13, PBF-21, PBF-22, and PBF-26. Visible access restrictions, control of activities, unauthorized access, and land-use restrictions were evaluated. No deficiencies were identified.

8.2.2 Corrosive Waste Sump (PBF-08 Site) and Evaporation Pond (PBF-10 Site)

Samples were taken of the residual sediments and surrounding soil above and below the evaporation pond liner, and radiological surveys were performed on the floor and walls of the corrosive waste sump. The radiological survey of the sump floor and walls found only fixed levels of contamination on the sump walls, ranging from 220 to 1,000 disintegrations per minute. Residual sediment samples collected above the evaporation pond liner showed Cs-137 concentrations of 11.2 to 17.5 pCi/g and chromium concentrations of 213 to 309 mg/kg, both below the established cleanup goals of 30 pCi/g for Cs-137 and 800 mg/kg for chromium. Soil samples collected below the evaporation pond liner also indicated chromium concentrations of 14.4 to 23 mg/kg (within background) with minor Cs-137 contamination. Based on these results, it was concluded that the pond liner was not breached during its operational lifetime and that all contaminants had been contained within the evaporation pond. The results also verified that the interim action could be considered complete.

Site restoration activities included backfilling and recontouring the area, followed by reseeding of the area. Interim action activities were completed in 1994. Because of its interim nature, a final ROD on the residual OU 5-13 site was not made until after the WAG 5 comprehensive ROD (OU 5-12) had been issued. Because of the lack of smearable contamination in the corrosive waste sump, however, it was anticipated that no further remedial actions or institutional controls would be required. In contrast, the Cs-137 concentration in the residual evaporation pond sediments was below cleanup goals, but the concentration was not below the free-release levels that have been set for Cs-137. Therefore, it was

anticipated that institutional controls would still be required on the evaporation pond until the Cs-137 has decayed to its free-release level. Both of these expectations were confirmed when the final OU 5-12 ROD was issued (DOE-ID 2000a).

8.2.3 Contaminated Soil beneath PER-751 Pump House Floor Slab and Foundation (PBF-37 Site)

Characterization sampling for metals and radionuclides before remediation at the PBF-37 site demonstrated that the only COC was Cs-137. After excavation of the contaminated soils at the site, in situ surveys of the excavation were performed, and confirmation samples were collected for laboratory analysis. The three in situ survey results ranged from 1.3 pCi/g to a maximum of 2.8 pCi/g. The analytical laboratory results for the two confirmation samples were 1.42 and 2.29 pCi/g. Based on the analytical results, it is being recommended in the forthcoming remedial action report that institutional controls will not be required for the site.

8.2.4 ARA-I Chemical Evaporation Pond (ARA-01 Site)

Screening sample results for arsenic at the ARA-01 site provided in situ measurements with a range of 4.8 to 9.5 mg/kg, while the in situ measurements for selenium were 0.4 to 2.0 mg/kg, and the in situ measurements for thallium were 1.3 to 2.4 mg/kg. The 95% upper confidence limit (UCL) for arsenic from the confirmation sample analytical results (calculated assuming a normal distribution in accordance with EPA guidelines) was 7.3 mg/kg, below the remedial action goal of 10 mg/kg. For selenium, all but one of the confirmation sample results was below the method detection limit with the single detectable concentration being 0.2 mg/kg as compared to the remedial action goal of 2.2 mg/kg. Assuming a non-parametric Chebyshev distribution (in accordance with EPA guidelines), the 95% UCL for selenium was calculated to be 0.11 mg/kg, below the remedial action level of 2.2 mg/kg. Based on a gamma distribution (again, in accordance with EPA guidelines), the 95% UCL for thallium from confirmation samples was 1.5 mg/kg, also below the remedial action goal of 4.3 mg/kg. By comparing the 95% UCL post-remediation concentrations to remediation goals, the remediation of the ARA-01 site was determined to be successful.

In accordance with the OU 5-12 ROD (DOE-ID 2000a), institutional controls were not required at ARA-01 after remediation, given that the COCs were inorganic (not radionuclides) and their post-remediation concentrations were below remedial action goals and therefore also below free-release levels.

8.2.5 ARA-I Sanitary Waste System (ARA-02 Site)

In situ measurements of the soil immediately underlying the seepage pit location demonstrated that the Cs-137 concentration remaining in the soil was 0.36 ± 0.13 pCi/g. This concentration is below the remediation goal of 8.5 pCi/g for Cs-137, which was established assuming that institutional controls would be in place for 100 years before the site could be turned over for residential use and the Cs-137 had decayed. It appears that the calculated 95% UCL for the residual Cs-137 contamination at the ARA-02 site was also below the established free-release concentration of 0.86 pCi/g. The concentrations of the remaining contaminants were derived, as provided in Table 8-6, using Cs-137 as a marker and assuming the concentrations of the other COCs present at the same ratio as the maximum concentrations provided in Table 21 of the OU 5-12 ROD (DOE-ID 2000a).

Table 8-6. Evaluation of the ARA-02 site remediation activities.

Contaminant of Concern	Maximum Concentrations before Remediation	Remediation Goal	Free-Release Concentration	Post-Remediation Concentration
Cs-137	178 pCi/g	8.5 pCi/g	0.86 pCi/g	0.36 pCi/g
Ra-226	89.6 pCi/g	1.2 or 2.1 pCi/g[a]	1.15 or 2.0 pCi/g[a]	0.18 pCi/g
U-235	120 pCi/g	6.2 pCi/g	6.2 pCi/g	0.24 pCi/g
U-238	190 pCi/g	10.6 pCi/g	10.6 pCi/g	0.38 pCi/g
Aroclor-1242	23.5 mg/kg	1 mg/kg	1 mg/kg	0.05 mg/kg
Lead	1,290 mg/kg	400 mg/kg	400 mg/kg	2.61 mg/kg

a. A goal of 2.1 pCi/g was used for comparison of sample results that might have included interference from U-235; otherwise, a goal of 1.2 pCi/g was used. Since U-235 was present at this site, the use of the 2.1-pCi/g remediation goal was appropriate even though the post-remediation concentration is well below either of the two Ra-226 remediation goal concentrations.

Based on comparison of the post-remediation concentrations to the remediation goals, the remediation of the ARA-02 site is successful. The residual concentrations left at the ARA-02 site also are below the free-release concentrations for all COCs. As a result, institutional controls will not be required at the ARA-02 site. Although areas of surface soil contamination still exist where the concentrations of Cs-137 are elevated, this contamination is attributed to the ARA-23 site and was addressed as part of the ARA-23 site remediation under Phase II remedial activities.

8.2.6 ARA-II Stationary Low-Power Reactor No. 1 Burial Ground (ARA-06 Site)

Post-excavation sampling of the contaminated soil area at the ARA-06 site confirmed that residual soil concentrations were equal to or less than the remedial action level of 16.7 pCi/g for Cs-137.

8.2.7 Radioactive Waste Leach Pond (ARA-12 Site)

After excavation, in situ measurements and confirmation samples were taken of the residual soil at the ARA-12 site. The 95% UCL calculation for in situ gamma measurements of Cs-137 (based on its perceived gamma distribution at the site, in accordance with EPA guidelines) was 0.43 pCi/g. This was below the Cs-137 cleanup goal of 0.75 pCi/g, implying that the remedial action was complete. The conclusion was confirmed by the more accurate confirmation sampling results, which showed a calculated 95% UCL for Cs-137 (again, based on a gamma distribution, in accordance with EPA guidelines) of only 0.38 pCi/g. Both 95% UCLs are not only below the cleanup goal (0.75 pCi/g) but also below the free-release concentration limit (0.64 pCi/g) for Ag-108m. Likewise, calculated 95% UCLs for the residual copper (based on a gamma distribution), mercury (based on a non-parametric Chebyshev distribution), and selenium concentrations (based on a normal distribution) at the ARA-12 site were found to be 27.5 mg/kg, 0.29 mg/kg, and 0.98 mg/kg, respectively. All of these 95% UCLs were below their respective remediation goals (220 mg/kg for copper, 0.5 mg/kg for mercury, and 2.2 mg/kg for selenium). All calculations were performed in accordance with EPA guidelines.

Based on the comparison of the post-remediation concentrations to the remediation goals, the remediation of the ARA-12 site was successful. In addition, institutional controls were not required at the ARA-12 site, because the concentration of Ag-108m in the residual soil after remediation was below the free-release concentration of 0.64 pCi/g, and the concentrations of inorganic contaminants in the remediated site were below remedial action goals.

8.2.8 ARA-I Radionuclide Tank (ARA-16 Site)

In situ measurement of the basalt/soil underlying the tank and vault at the ARA-16 site demonstrated that the maximum Cs-137 concentration in the remediated site was 1.5 pCi/g, well below the remediation goal of 23 pCi/g for Cs-137. As a result, remediation of the ARA-16 site was successful. The maximum concentration of Cs-137 in the remediated site also was below the free-release concentration of 2.4 pCi/g. Given that fact, institutional controls at the ARA-16 site are no longer required. Although Cs-137 was still present in surficial soils (similar to the ARA-02 site), that contamination was attributed to windblown contamination from the SL-1 accident and was addressed as part of the Phase II remedial action for the ARA-23 site.

8.2.9 Radiologically Contaminated Surface Soil and Subsurface Structures associated with ARA-I and ARA-II (ARA-23 Site)

Because of the size of the ARA-23 site excavation, the post-remediation evaluation activities (via sampling) were separated into five zones. The various zones of the excavation were as follows:

- Area near the ARA-I facility
- Area near the ARA-II facility
- Equipment washdown area
- Haul road and turnaround area
- Windblown area.

A review of the contamination profiles for both in situ measurements and confirmation samples found that the contamination profiles generally followed a log-normal distribution rather than a normal distribution. The only exceptions to this were the confirmation samples in the washdown area and the in situ measurements in the haul road and turnaround area.

Residual sampling results, for the ARA-I area of the ARA-23 site after remediation showed 95% UCL Cs-137 concentrations of 8.5 pCi/g for the in situ measurements (based on a gamma distribution, in accordance with EPA guidelines) and 22.3 pCi/g for the confirmation samples (based on a non-parametric Chebyshev distribution). Both calculated values were below the remedial action goal of 23 pCi/g for Cs-137. Therefore, remediation of the ARA-I excavation site within the ARA-23 site was considered complete.

For purposes of evaluating the ARA-II portion of the ARA-23 site, the data had to be split into samples collected from (1) the basalt surface where excavation was to that surface and (2) samples collected from excavated soil areas. This was because the RAOs were to either excavate to basalt or excavate enough of the soil to meet the remedial action goal of 23 pCi/g for Cs-137. In situ measurements, post-remediation for the ARA-II areas in the ARA-23 site that were not excavated to basalt showed a 95% UCL Cs-137 concentration of 8.6 pCi/g (based on a normal distribution, in accordance with EPA guidelines), which was below the remedial action goal of 23 pCi/g for Cs-137. The confirmation sample data for the ARA-II site projected a 95% UCL (based on a normal distribution, in accordance with EPA guidelines) of 11.1 pCi/g, also below the remedial action goal of 23 pCi/g for Cs-137. As a result, remedial actions for the ARA-II portion of the ARA-23 site were judged to be complete in that the residual soil surface at ARA-II met the remediation goals for Cs-137.

Residual sampling results for the equipment washdown area of the ARA-23 site after remediation showed 95% UCL concentrations of 8.4 pCi/g for Cs-137 for the in situ measurements (based on a gamma distribution, in accordance with EPA guidelines) and 12.9 pCi/g for the confirmation samples (based on a normal distribution). Both calculated values were below the remedial action level of 23 pCi/g, indicating that the remediation was complete.

In situ measurements and confirmation sample results for the haul road and turnaround area of the ARA-23 site followed a gamma distribution, in accordance with EPA guidelines. The calculated 95% UCL Cs-137 concentrations of the residual soil surfaces were 7.4 pCi/g for the in situ measurements and 24.9 pCi/g for the confirmation samples. While the in situ measurements were below the remedial goal for Cs-137 (23 pCi/g), the confirmation sample results were just above the remediation goal. The reason for this was that one of these 10 samples had a Cs-137 concentration above the remediation goal of 23 pCi/g (ARA-23H-20 was 56.3 pCi/g). The same sample location provided an in situ Cs-137 concentration of 11.7 pCi/g. The high Cs-137 concentration in this single confirmation sample was attributed to a "hot particle" that incorrectly skewed the 95% UCL calculation to a level above the remediation goal and could be screened from the confirmation sample evaluation. The new 95% UCL that was calculated for Cs-137 from the other nine confirmation samples (under a normal distribution, in accordance with EPA guidance) was only 9.5 pCi/g, below the remedial action goal of 23 pCi/g. Therefore, remediation of the haul road and turnaround area of the ARA-23 site was considered complete.

In situ measurements for the windblown area of the ARA-23 site, post-remediation, had a 95% UCL Cs-137 concentration of 9.3 pCi/g based on a normal distribution. Confirmation samples of the windblown area based on a gamma distribution provided a 95% UCL of 9.6 pCi/g for Cs-137. Both 95% UCLs were below the remediation goal for Cs-137 (23 pCi/g). As a result, remediation of the windblown area of the ARA-23 site was considered complete.

A summary of the residual concentrations in the excavated soil (and basalt) areas of each portion of the ARA-23 site is shown in Table 8-7. Based on the comparison of the post-remediation concentrations to the remediation goal, the remediation of the ARA-23 site was determined to be successful. However, the presence of Cs-137 contamination in excess of the free-release concentration of 2.4 pCi/g requires that institutional controls remain in place.

Table 8-7. ARA-23 site Cs-137 data summary by area.

Area	In Situ Measurements Cs-137 (pCi/g)	Confirmation Sampling Cs-137 (pCi/g)
ARA-I	8.5[a]	22.3[b]
ARA-II	8.6[c] (soil)/52.1[a] (basalt)	11.1[c] (soil)/83.8[a] (basalt)
Equipment washdown	8.4[a]	12.9[c]
Haul road and turnaround	7.4[a]	9.5[c,d]
Windblown	9.3[c]	9.6[a]

a. 95% UCL, determined under a gamma distribution, in accordance with EPA guidelines
b. 95% UCL, determined under a non-parametric Chebyshev distribution, in accordance with EPA guidelines
c. 95% UCL, determined under a normal distribution, in accordance with EPA guidelines
d. With single outlier sample removed

EPA = U.S. Environmental Protection Agency
UCL = upper confidence limit

8.2.10 ARA-I Soil beneath the ARA-626 Hot Cells (ARA-25 Site)

In situ measurements of the exposed basalt layer at the ARA-25 site showed a maximum Cs-137 concentration of 398 pCi/g in the basalt—in excess of the 23-pCi/g remediation goal. The measured Cs-137 concentrations were used to calculate concentrations of the remaining COCs. The concentration of Cs-137 and those derived for the other COCs are provided in Table 8-8. Although all the remaining contaminant concentrations (except copper) exceeded their remediation goals, the OU 5-12 ROD (DOE-ID 2000a) stated that remedial goals can be satisfied by either cleaning up to the identified contaminant concentration or by removing all soil down to the basalt interface. Because the contaminated soil was removed down to the basalt interface, the remediation of the ARA-25 site was successful. However, the presence of high levels of Cs-137 within the basalt required the use of institutional controls at the ARA-25 site. Because the residual contamination was higher than remediation goals, institutional controls will be needed at the ARA-25 site longer than the assumed 100 years. As a result, monuments were placed on top of the site, as were sign postings and personnel access restrictions that commonly accompany institutional controls.

Table 8-8. ARA-25 site contaminant concentration evaluation.

Contaminant of Concern	Maximum Concentration before Remediation	Maximum Post-Remediation Concentration	Remediation Goal
Cs-137	449 pCi/g	398 pCi/g	23 pCi/g
Ra-226	29.7 pCi/g	26.3 pCi/g	1.2 or 2.1 pCi/g[a]
Arsenic	40.6 mg/kg	36.0 mg/kg	5.8 mg/kg
Lead	1,430 mg/kg	1,266 mg/kg	400 mg/kg
Copper	227 mg/kg	201 mg/kg	220 mg/kg

a. A goal of 2.1 pCi/g was used for comparison of sample results that might have included interference from U-235; otherwise, a goal of 1.2 pCi/g was used. Regardless of which remediation goal concentration was used for comparison, the post-remediation concentration clearly exceeds either one.

8.2.11 Inactive Waste System Sites

ARA-II Seepage Pit to the East (ARA-720A) (ARA-07 Site)—Based on June 1991 data, the maximum concentration of Cs-137 at the ARA-07 site was found to be 17.6 pCi/g. Accounting for radioactive decay, the corrected Cs-137 concentration (to September 2004) is 13.0 pCi/g. Though cleanup was not required, the residual Cs-137 concentration was still above the free-release concentration of 2.4 pCi/g established at the time. As a result, sufficient Cs-137 contamination existed to warrant institutional controls being established at the site. The institutional controls consist of visible access restrictions (i.e., CERCLA signs) and prevention of unauthorized access (i.e., the INL Site security gate). The institutional control requirement is to be reviewed every 5 years.

ARA-II Seepage Pit to the West (ARA-720B) (ARA-08 Site)—Based on June 1991 data, the maximum concentration of Cs-137 at the ARA-08 site was 11.6 pCi/g. This corresponds to a September 2004 Cs-137 concentration of 8.6 pCi/g. Though cleanup was not required, the residual Cs-137 concentration was still above the free-release concentration of 2.4 pCi/g established at the time. As a result, sufficient contamination existed to warrant institutional controls being established at the site. The institutional controls consist of visible access restrictions (i.e., CERCLA signs) and prevention of

unauthorized access (i.e., the INL Site security gate). The institutional control requirement is to be reviewed every 5 years.

ARA-III Sanitary Sewer Leach Field (ARA-740) (ARA-13 Site)—Results from sampling at the ARA-13 site showed that waste from the manhole was nonhazardous and nonradioactive. The sludge from the septic tank system also was not hazardous but contained levels of Cs-137 below the free-release concentration of 2.4 pCi/g. As a result, a decision was made to manage all sludge from the ARA-13 site as low-level waste. Sludge from the distribution box was found to be regulated under the TSCA (15 USC § 2601 et seq.) because of PCB concentrations in excess of 50 parts per million (ppm).

After removal of the sludge from the septic tank and distribution box, no evidence of additional hazardous or radioactive contamination was found in the soil surrounding these systems. In addition, analytical data from the leach field showed that contamination levels were not a problem and that leaving the leach field in place was the best management practice. As a result, the sites can be considered closed, with no further institutional controls required.

ARA-IV Septic Tank and Seepage Pit #2 (ARA-21 Site)—The ARA-21 site sampling was done before remediation to determine waste disposition paths for the septic tank, the chlorine contact tank, and the liquid waste contained in them. Based on analytical data, it was determined that the components would be abandoned in place; therefore, sampling of the individual components was not required. Analytical data for the ARA-21 site showed K-40 concentrations of 85.8 ± 22.1 pCi/L in the septic tank and 97.0 ± 26.0 pCi/L in the chlorine contact tank. Gross beta levels were 42.4 ± 3.14 pCi/L in the septic tank and 62.8 ± 4.4 pCi/L in the chlorine contact tank, while gross alpha concentrations were within normal levels. Inorganic and organic analyses indicated that all of the waste met RCRA regulatory limits (42 USC § 6901 et seq.). The lack of hazardous or radioactive contamination at the ARA-21 site after remediation allowed for the site to be closed without any institutional controls.

8.2.12 Groundwater Monitoring

The OU 5-12 ROD (DOE-ID 2000a) required that nine aquifer wells within WAG 5 be sampled annually to monitor organic, inorganic, and radionuclide contaminant concentrations in the groundwater. The purpose of the monitoring was to compare the measured contaminant concentrations (if any) against the pre-defined MCLs, secondary MCLs, or EPA action levels and to ascertain whether the contaminant concentrations are stable, increasing, or decreasing. In addition, up to 21 monitoring wells in the vicinity of WAG 5 have been used to determine the elevation of the groundwater, groundwater gradients, and direction of groundwater flow beneath WAG 5. Annual monitoring of WAG 5 wells has been conducted since FY 2001 (INEEL 2001; INEEL 2002a; INEEL 2003a; ICP 2004).

8.2.12.1 Volatile Organic Compound Results. Sporadic detections of VOCs have been reported for the WAG 5 groundwater samples, but consistent VOC detections have not occurred. There were scattered detections of the VOCs like toluene and trichloroethene, but detections were not consistent and were well below their respective MCLs except for PCE in FY 2003. In the FY 2003 sampling event, PCE concentrations above its MCL of 5 μg/L were reported for groundwater samples from the ARA-MON-A-004 and PBF-MON-A-004 wells. However, PCE was below the reporting limit of 1 μg/L in both wells in the FY 2004 sampling event.

8.2.12.2 Inorganic Results. Inorganic analyses included metals and anions. Specific metals requested included arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Anion analysis included fluoride, chloride, bromide, nitrate, nitrite, orthophosphate, and sulfate. In FY 2003 and FY 2004, all analytical results for metals and anions were below the MCLs, secondary MCLs, or action

levels. In previous sampling events, lead had been detected at concentrations slightly above the EPA action level of 15 μg/L in some wells (Table 8-9).

The cause of the elevated lead concentrations was the galvanized discharge and water-access pipes. Excluding the production well, SPERT I, each of the WAG 5 groundwater monitoring wells were installed with galvanized discharge and water-access pipes. As part of the INL Site routine well maintenance program, pumps were removed and maintained, and galvanized pipes were removed and replaced with stainless-steel pipes. Galvanized pipes removed from WAG 5 wells showed evidence of corrosion and rusting. By FY 2004, the galvanized pipe had been replaced by stainless-steel pipe in the ARA/PBF wells, and the lead concentrations decreased to background levels (Table 8-9). The decline in lead concentrations after replacement of the corroded galvanized pipe implies that the elevated lead concentrations were due to corrosion of the galvanized pipe in the wells.

Table 8-9. Lead concentrations in the Waste Area Group 5 groundwater monitoring wells.

Sample Identification Number	Lead Concentration (μg/L) (Action Level = 15 μg/L)			
	FY 2001	FY 2002	FY 2003	FY 2004
ARA-MON-A-001	9.9	11.9	11.9	2.96[a]
ARA-MON-A-002	6.9	12.7	<2.5[a]	2.79/2.59
ARA-MON-A-03A	13	**15.6**[b]	<2.5[a]	NS
ARA-MON-A-004	13.2	**17.0**[b]	<2.5[a]	2.83
PBF-MON-A-001	1.2[a]	<1.6	<2.5	<2.14
PBF-MON-A-003	<1.1	<1.2	NS	1.8
PBF-MON-A-004	**17.5**[b]	**17.1**[b]	13.9	<1.77[a]
PBF-MON-A-005	<1.1[a]	<1.6	<2.5	2.58
SPERT-I[c]	3.2	<1.6	<2.5	<2.14

a. First groundwater measurement after well casing conversion from galvanized steel to stainless steel
b. Concentrations are over the EPA-defined action level.
c. Well casing was always stainless steel.

ARA = Auxiliary Reactor Area
EPA = U.S. Environmental Protection Agency
FY = fiscal year
NS = not sampled
PBF = Power Burst Facility
SPERT = Special Power Reactor Excursion Test

8.2.12.3 Radionuclide Results. Radionuclide analyses included gross alpha and beta, gamma spectrometry, tritium, and I-129. The laboratory was requested to do alpha and beta isotopic analyses only if the corresponding gross alpha or gross beta sample result exceeded 5 pCi/L. Because this did not occur for any of the well samples analyzed, isotopic tests were unnecessary. Since 2000, tritium has not been detected in any of the WAG 5 samples.

There were scattered detections of I-129, but no well had consistent I-129 detections. In most cases, the I-129 detections were close to the minimum detectable activity. The one instance when I-129 was detected occurred in 2001 at PBF-MON-A-001 at 1.02 ± 0.26 pCi/L (barely above the drinking water MCL of 1 pCi/L). That detection was attributed to laboratory contamination and flagged UJ, because I-129 was detected in a rinsate sample at a similar concentration as well as in the laboratory blank.

There were scattered detections of Cs-134 in FY 2003 and FY 2004. These detections were close to or below the minimum detectable activity for this analysis and were flagged with a "J" by the validator, indicating that the result might be inaccurate or imprecise. Although Cs-134 was found to be present statistically, the result is questionable. Cs-137 is generally expected to be present when Cs-134 is detected, especially given the fact that Cs-134 has a 2.06-year half-life as compared to a 30.17-year half-life for Cs-137. However, Cs-137 was not detected in any of the samples. In addition, reactor operations that could have contributed to the presence of either isotope ceased at PBF in February 1985.

8.2.12.4 Water-Level Measurement Results. Water-level measurements were obtained from seven monitoring wells in 2001, eight wells in 2002, 21 wells in 2003, and 19 monitoring wells in 2004 at WAG 5. The number of wells measured for water levels was expanded in 2003 and 2004 to give a better representation of the water table at WAG 5. Like past groundwater contour maps of WAG 5, the contour map of the April 2004 data shows steep contours in the PBF area with the direction of hydraulic gradient somewhat counter to the regional south-southwest gradient (Figure 8-5).

8.2.13 Institutional Controls

Institutional controls have been warranted for many of the WAG 5 sites because of the presence of radionuclides above concentrations that would allow for free release. Given the revised preliminary remediation goals that have been calculated based on the most recent of the sites' EPA guidance (see Appendix A), several sites no longer require institutional controls as described in the following subsections.

8.2.13.1 ARA-I Lead Sheeting Pad near ARA-627 (ARA-03 Site). The estimated baseline risk for the ARA-03 site was 2E-05 for the 100-year future residential scenario from exposure to Cs-137 (DOE-ID 1999) with analytical results ranging from 0.49 to 7.4 pCi/g for samples obtained on September 27, 1994. Based on this risk, the ROD (DOE-ID 2000a) recommends that the site be restricted to industrial land use until institutional controls are discontinued based on the results of a five-year review. The 1994 data set was evaluated for normality using the Shapiro-Wilk test statistic, which indicated that the data were normally distributed at the 5% significance level. The 95% UCL for the data set using the Student's t was 5.00 pCi/g, which equates to 3.94 pCi/g when decay corrected to January 24, 2005. Based on the concentrations provided in Appendix A, the allowable concentration for the current residential scenario below which institutional controls are no longer required is 5.97 pCi/g. Based on this concentration, institutional controls are no longer required for the ARA-03 site.

8.2.13.2 Power Burst Facility SPERT-IV Leach Pond (PBF-758) (PBF-22 Site). The PBF-22 site was the location of an unlined surface impoundment that received effluent from the SPERT-IV reactor from 1961 to 1970. Occasional discharges from the SPERT-IV waste holdup tank were routed to the pond from 1979 to 1981. Contaminated primary coolant effluents from the PBF reactor were transported to the site by truck and emptied into the pond in the early 1980s. Given the results of two separate characterization events in 1988, institutional controls were implemented at the site based on exposure risks being 9E-06 for Cs-137 for the current occupational scenario and 3E-06 for the 100-year future residential scenario, as outlined in the ROD (DOE-ID 2000a). The Cs-137 results ranged from 0.073 to 8.0 pCi/g with an average of 1.10 pCi/g. The 99% Chebyshev UCL (used because the data follow a non-parametric distribution) is 4.42 pCi/g for the 1988 data set. Based on this concentration being below the 5.97-pCi/g requirement for free release, institutional controls are no longer required at this site.

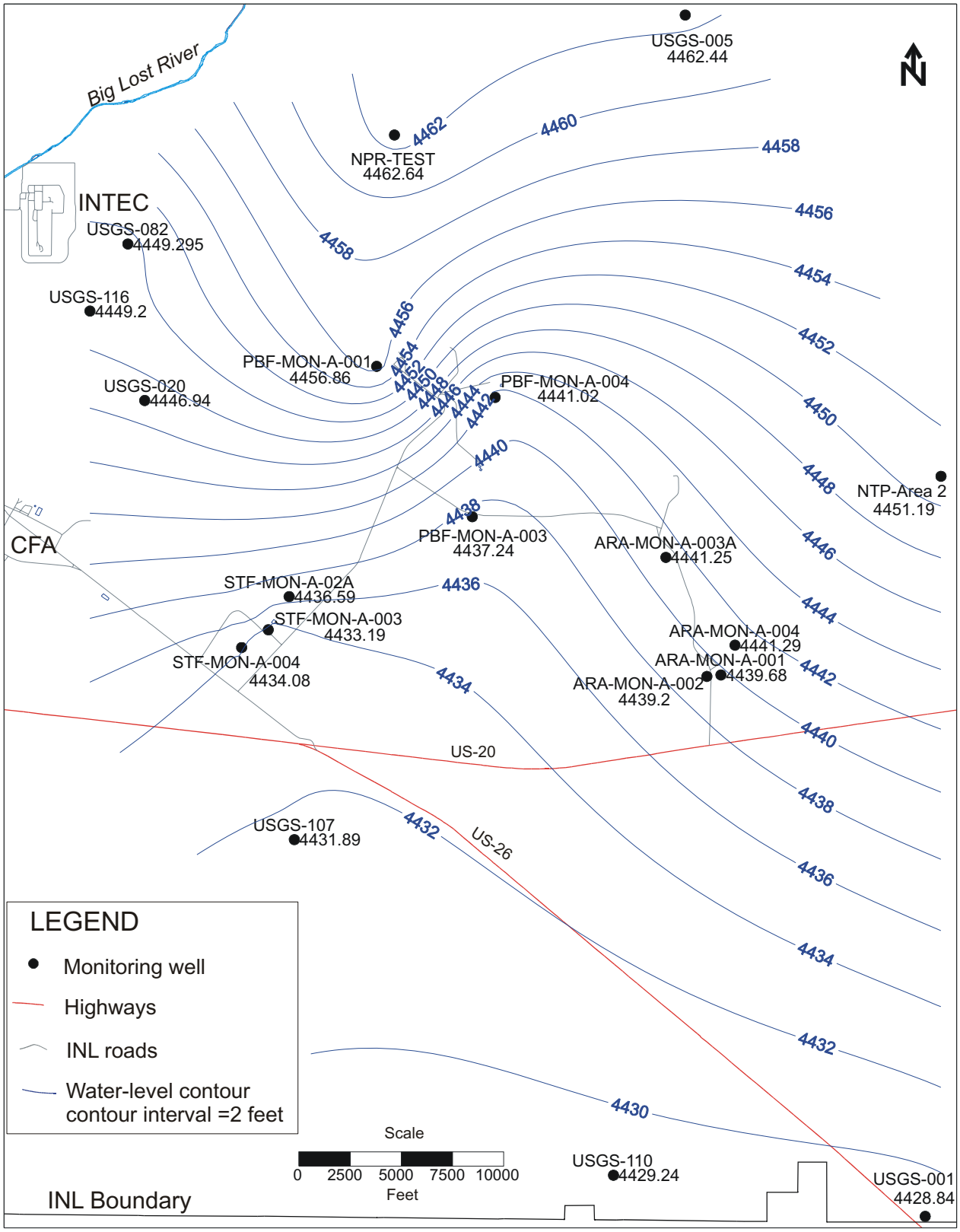


Figure 8-5. Waste Area Group 5 groundwater contour map developed from April 2004 data.

8.2.13.3 Power Burst Facility SPERT-IV Lake (PBF-26 Site). The PBF-26 site is a surface impoundment area constructed in 1960 around an irregularly shaped natural depression. The area typically received small quantities of uncontaminated cooling water from the secondary loop of the SPERT-IV reactor from 1961 to 1970, uncontaminated effluent from Three-Mile Island studies, and discharges generated by periodic testing of emergency eye wash and shower stations from 1985 to 1992. The site is restricted to industrial land use because of estimated baseline risks of 7E-05 for the current occupational scenario and 6E-05 for the 100-year future residential scenario from exposure to radionuclides (Cs-137, U-235, and U-238). Table 8-10 lists the radionuclides detected during the 1985 sampling event, including the range, the average, the 95% UCL (including the data distribution), and the 1E-04 current residential scenario concentrations for the three radionuclides of concern from Appendix A, as calculated based on new slope factors.

Table 8-10. PBF-26 site radionuclide concentrations.

Radionuclide	Range (pCi/g)	Average (pCi/g)	95% UCL (pCi/g)	Current Residential Scenario (pCi/g)
Cs-137	0.70–7.69	2.79	4.67 (Student's t)	5.97 (external exposure)
U-235	0.80	NA	NA	19.5 (external exposure)
U-238	0.80–3.4	2.1	NA	74.2 (external exposure)

NA = not applicable
UCL = upper confidence limit

For U-235 and U-238, too few sample results were available from which to calculate the 95% UCL. Therefore, the maximum concentration detected will be used for comparison to the current residential scenario concentration. Both the U-235 and U-238 maximum concentrations (0.80 and 3.4 pCi/g, respectively) are below the corresponding current residential scenario concentrations of 19.5 and 74.2 pCi/g. Based on these comparisons, the presence of neither of these radionuclides is cause for institutional control restrictions on the site. Cs-137, with a 95% UCL concentration of 4.67 pCi/g for the 1985 data set, is below the current residential scenario concentration of 5.97 pCi/g. Based on this concentration being below the 5.97-pCi/g requirement for free release, institutional controls are no longer required at this site.

8.3 Progress since Last Review

The OU 5-05 ROD (INEL 1996) is the only WAG 5 ROD that has undergone a previous five-year review. That ROD addressed the remediation of the SL-1 burial ground. In 2001, the EPA conducted the first five-year review of the OU 5-05 ROD (EPA 2001). The report documented completion of the OU 5-05 remedial action in 1997 and concluded that the engineered barriers placed over the SL-1 burial ground appeared intact with no visible evidence of subsidence or erosion and no evidence of weeds, shrub encroachment, or other biointrusion into the barriers. The revegetated areas surrounding the site appeared to be fixed and well established with no indication of any surface erosion; all institutional markers (fences, signs, posted notices, and permanent markers) were in place and intact. As a result, the remedial actions performed on the SL-1 burial ground were judged to be effective in meeting the site's RAOs.

A review of the 2002 and 2003 inspection reports (INEEL 2002b; INEEL 2003b) for the SL-1 burial ground showed that conditions were similar to those at the time of the initial five-year review. The engineered barriers still appeared intact, with no visible signs of erosion. Although rabbit nesting was

observed in the vicinity of the SL-1 engineered barrier, it appeared very unlikely that the rabbits posed a threat to the integrity of the SL-1 cover. In addition, the revegetated areas surrounding the SL-1 engineered barrier remained free of erosion, and all of the institutional controls are intact and up-to-date. Although vegetation was encroaching on the SL-1 engineered barrier in 2002, vegetation appeared to be absent in 2003. Dose rates around the perimeters of the SL-1 burial ground remained consistent with past survey results. As a result, the remedial actions at the SL-1 burial ground still appear to be effective in meeting the site's RAOs.

8.3.1 Issues Identified during the First Operable Unit 5-05 Five-Year Review

The only issue identified during the OU 5-05 five-year review was the presence of windblown contamination in the area surrounding the SL-1 burial ground. The contamination was initially identified as part of the *OU 5-05/6-01 SL-1/BORAX Annual Inspection Report* (INEEL 1998). The five-year review indicated that the windblown contamination was to be removed during Phase II of the WAG 5 comprehensive (OU 5-12) remedial action. For purposes of completion, the Phase II soil removal action needs to be summarized as part of this review.

The five-year review also mentions that no groundwater monitoring requirements were included in the SL-1 remedy. Rather, groundwater monitoring requirements were addressed by the WAG 5 ROD (DOE-ID 2000a), which found no unacceptable risk due to impacts on groundwater. Nevertheless, groundwater monitoring was required as part of the first OU 5-12 comprehensive review in order to reduce uncertainties and provide trend data. This monitoring is summarized in Section 8.2.12.

8.3.2 Response Actions to Issues Identified during the First Five-Year Review

Since the time of the first review, remediation of the windblown contamination in the vicinity of the SL-1 burial ground was removed as part of the ARA-23 site soil removal action performed in 2004. Details of the removal action are documented in Section 8.1.3.8. The results showed that all contaminated soils were removed to a level below the remedial action goal of 23 pCi/g for Cs-137. However, the residual soil areas within the ARA-23 site maintained a Cs-137 concentration in excess of the free-release concentration of 2.4 pCi/g. In addition, areas within the basalt subsurface that were not excavated indicated Cs-137 contamination in excess of both the free-release concentration and the remedial action goal (2.4 pCi/g and 23 pCi/g, respectively). As a result, institutional controls will need to be maintained over the windblown contamination area as well as the SL-1 burial ground until the Cs-137 contamination in the basalt, waste, and residual soil drops below free-release concentrations.

8.3.3 Ongoing Remediation Activities

As of September 2004, all remedial actions identified in the OU 5-13 ROD, the OU 5-05 ROD, and the OU 5-12 ROD have been completed. Details associated with the remedial actions are contained in the respective remedial action reports for each ROD (DOE-ID [1992a] for OU 5-13, DOE-ID [1997] for OU 5-05, and DOE-ID [2002] and a report to be published for OU 5-12).

The only ongoing remediation activity is the groundwater monitoring activities that are under way as part of OU 5-12.

8.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

According to sampling data and site inspections, all COCs are at or below regulatory action levels. However, at some of the sites, contaminants are present at concentrations that prohibit unrestricted use of or unrestricted access to the site. At sites where contaminant concentrations prohibit free release of the site, institutional controls have been implemented. Therefore, the remedial actions implemented at WAG 5 are functioning as intended.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

No changes that would negatively impact the original assumptions for exposure assumptions or toxicological parameters have occurred since development of final remedial goals. Therefore, the original assumptions, cleanup levels, and RAOs used at the time of the remedy selection are still valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No.

8.5 Issues

Based on recent EPA-approved guidelines, the revised free-release concentration for Cs-137 is 5.97 pCi/g. This is due to a soil shielding factor that was included in the latest risk models. Before the next five-year review, the DOE-ID, with agency concurrence, will determine how best to address the impact that the new guidelines have on the duration of institutional controls. For WAG 5, the new guidelines would allow for institutional controls to be discontinued at the ARA-03, PBF-22, and PBF-26 sites. For a list of issues identified within all WAGs during the INL Sitewide five-year review in 2005, see Table C-1 in Appendix C.

8.6 Recommendations and Follow-up Actions

The institutional controls that are currently in place for the 13 waste sites within WAG 5 appear to be functional and should be left in place for most of the sites until the radioactive residual contamination in these sites drops below free-release concentrations. The free-release concentration for Cs-137 (the primary radionuclide COC) was established at 2.4 pCi/g, which is equivalent to a 1 E-4 risk for residential use.

As stated above, a four-year review of groundwater monitoring activities within WAG 5 showed that the existing groundwater flow and elevation underneath WAG 5 are not varying significantly and that the concentrations of organic, inorganic, and radionuclide contamination in the groundwater are substantially below EPA-defined regulatory levels. As a result of these findings, it is recommended that the majority of inorganic, radionuclide, and groundwater-level monitoring should be terminated at WAG 5. To provide adequate data for wells that have undergone replacement of the galvanized piping with stainless-steel piping within the past 2 years, an additional round of samples will be collected specifically for lead and zinc analyses. Provided that this additional round supports the assertion that contaminant concentrations have decreased to acceptable levels, sampling for these analytes will be discontinued. Organic groundwater monitoring will be continued on only the three monitoring wells

(PBF-MON-A-001, PBF-MON-A-003, and SPERT-I) within the vicinity of the PER-722 diesel fuel release behind the PBF Reactor Building (PER-620). Furthermore, it is recommended that organic groundwater monitoring of these three wells be terminated in 2006 if monitoring results continue to indicate that organic contaminant concentrations in the groundwater are below regulatory concern.

8.7 Protectiveness Statement

Review of the results of the groundwater monitoring activities and annual inspection reports conducted at WAG 5 since 2001 shows that the remedy is functioning as intended by the OU 5-12 ROD (DOE-ID 2000a) and as modified by its ESD (DOE-ID 2005). No changes in the physical conditions of the site have occurred that would affect the remedy's protectiveness. As of September 2004, no changes have occurred in the COC toxicity factors or risk factors that would negatively impact the protectiveness of the remedy. A total of 13 hazardous sites within WAG 5 remain under institutional controls. In addition, recommendations are to continue groundwater monitoring for organic contamination on three of the monitoring wells within WAG 5 (PBF-MON-A-001, PBF-MON-A-003, and SPERT-I). However, all of these actions are in accordance with the intent of the OU 5-12 ROD (DOE-ID 2000a). None of the available information negates the protectiveness of the OU 5-12 remedies.

8.8 Section 8 References

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42 USC § 6901 et seq., 1976, "Resource Conservation and Recovery Act of 1976," *United States Code*, October 21, 1976. (The 1980 Amendment is cited as the "Solid Waste Disposal Act Amendments of 1980.")

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9. WASTE AREA GROUP 6 (EXPERIMENTAL BREEDER REACTOR I AND BOILING-WATER REACTOR EXPERIMENT)

The Experimental Breeder Reactor (EBR) -I was established in the early 1950s to test the theory that a reactor could produce more fuel than it uses and became the first reactor to generate electricity. In 1953, tests conducted at the EBR-I proved that a reactor could create more fuel than it used, even while it created electricity. In 1963, reactor operations at EBR-I ceased.

Less than a mile from EBR-I at the Boiling-Water Reactor Experiment (BORAX) area, five reactor experiments were conducted between 1953 and 1964. These experiments began with BORAX-I, which was used to demonstrate the feasibility of boiling water reactors. The BORAX-I reactor was intentionally destroyed in 1954 to determine its inherent safety under extreme conditions. It was then buried in place.

In late 1954, another BORAX facility was constructed a few hundred feet northeast of BORAX-I. Over the next 10 years, three reactors (BORAX-II, BORAX-III, and BORAX-IV) shared the same reactor vessel, but the experiments used different fuel designs and core configurations. The BORAX-V reactor also shared the same facility but used a new reactor vessel and core system.

Past operations and support activities at the EBR-I and BORAX areas resulted in the release of radioactive contamination. To facilitate cleanup of the contamination, EBR-I and BORAX were designated as WAG 6 in accordance with the FFA/CO (DOE-ID 1991). Because they are located within 1 mi of each other and have similar operational backgrounds and sources of contamination, the WAG 6 boundary encompasses both facilities and the immediately adjacent surface and subsurface areas. Table 9-1 summarizes the COCs and remediation goals for WAG 6 sites where a remedial action was performed.

Table 9-1. Contaminants of concern at Waste Area Group 6.

Site (Site Code)	COC	Concentration	Remediation Goal
BORAX-I Burial Ground (BORAX-02)	Cs-137	95% UCL—1,817 pCi/g	16.7 pCi/g
	Sr-90	95% UCL—2.0 pCi/g	10.8 pCi/g
	U-235	95% UCL—68.6 pCi/g	13.2 pCi/g
BORAX Ditch (BORAX-08)	Cs-137	Maximum—2,130 pCi/g	16.7 pCi/g
Radioactive Soil Contamination at EBR-I (EBR-15)	Cs-137	Maximum—14,600 pCi/g	16.7 pCi/g

BORAX = Boiling-Water Reactor Experiment
COC = contaminant of concern
EBR = Experimental Breeder Reactor
UCL = upper confidence limit

The *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001) was incorporated into OU 10-04 in accordance with the FFA/CO (DOE-ID 1991). The OU 10-04 RI/FS (DOE-ID 2001) evaluated 50 potential release sites, including 22 sites at WAG 6 (14 at EBR-I and eight at the BORAX area). Other than limited actions consisting of institutional controls, all remedial actions have been completed at the WAG 6 sites.

The CERCLA sites at WAG 6 are illustrated in Figure 9-1. Except for the active septic system that supports the EBR-I National Historic Landmark, most of the tanks and inactive septic systems have been removed from the EBR-I area. The radionuclide-contaminated soil outside of the EBR-I building was removed in 1995.

The CERCLA sites related to BORAX include underground storage tanks, septic systems, a leach pond, a ditch, a trash dump, and two former reactor sites. Other than fences, none of the aboveground structures related to BORAX remain, and all of the tanks and septic systems have been removed. The BORAX leach pond was filled with clean dirt in 1985, and the radionuclide-contaminated soil in the BORAX ditch was removed in 1995. All of the waste material was removed from the BORAX trash dump in 1985. The BORAX-I, BORAX-II, BORAX-III, and BORAX-IV reactor fuels and vessel components were dispositioned by Argonne National Laboratory-West (ANL-W) personnel at the completion of each respective experiment. At the completion of the BORAX-V experiments, all of the reactor fuel and portions of the internal reactor were removed by ANL-W personnel for dispositioning. Later, several phases of D&D removed the BORAX-V aboveground facility structures, stabilized the remaining underground structures, filled the basement with soil, and replaced concrete foundation blocks over the basement. The radionuclide-contaminated soil related to the BORAX-I reactor was remediated in 1997 (DOE-ID 1997) under the *Record of Decision Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INEL 1996a), and an engineered barrier cap was placed over the former reactor site.

Two RODs have been prepared for remediation activities within WAG 6. The first ROD, issued in January 1996, focused on remediation of BORAX-02. The *Record of Decision Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INEL 1996a) required the consolidation of contaminated materials at the site of the original BORAX-I reactor burial ground and construction of a human intrusion barrier over the site (Figure 9-2). The *Record of Decision Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04* (DOE-ID 2002) provided for implementation of institutional controls at selected no-further-action sites at WAG 6. In addition, a 1995 CERCLA non-time-critical removal action addressed radionuclide-contaminated soil under OU 10-06 at the EBR-15 site and the BORAX-08 ditch (Figure 9-3), as outlined in the *Engineering Evaluation/Cost Analysis for Operable Unit 10-06 Radionuclide-Contaminated Soils Removal Action at the Idaho National Engineering Laboratory* (INEL 1995a).

Table 9-2 provides a chronology of the WAG 6 remedial action events.

9.1 Remedial Actions

As stated previously, two RODs have been prepared for contaminated sites within WAG 6, and one non-time-critical removal action has been performed. Based on these activities, remedial actions were conducted at three individual sites with institutional controls being required at two of the three sites. In addition to these two sites, institutional controls have been identified for three additional WAG 6 sites. Details of the remedial actions are described in the following subsections.

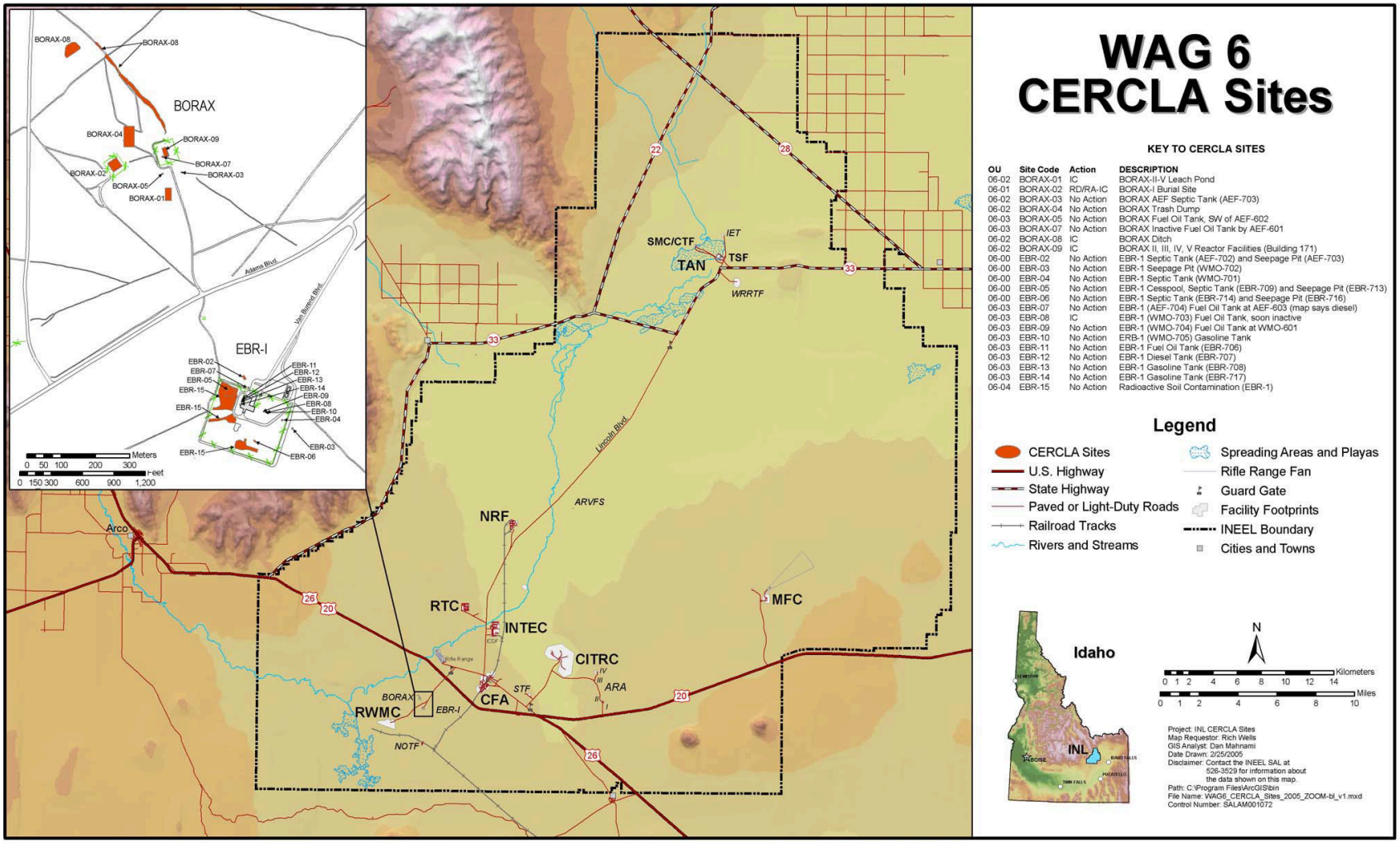

Figure 9-1. Waste Area Group 6 CERCLA sites.

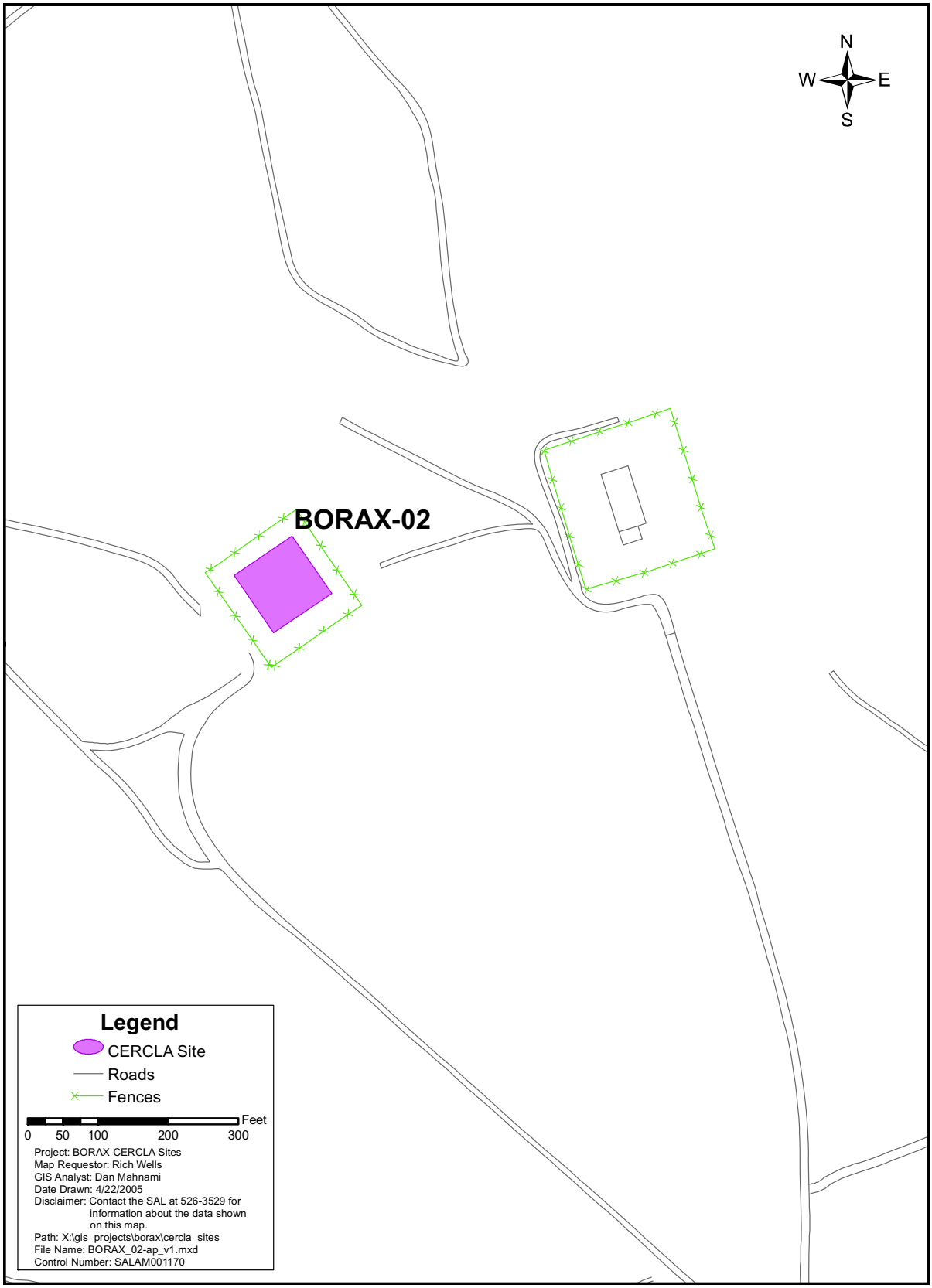

Figure 9-2. BORAX-02 burial ground.

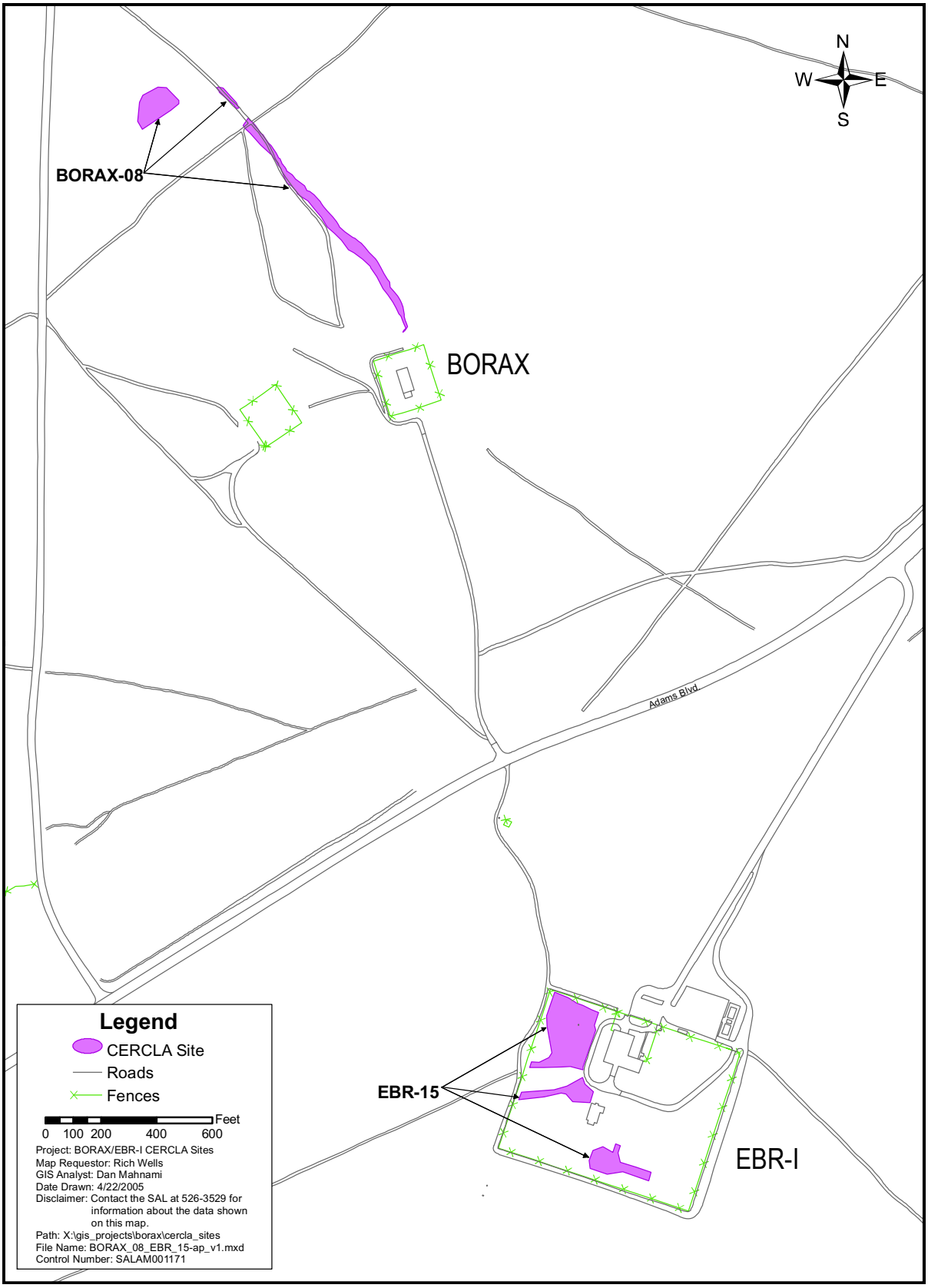

Figure 9-3. BORAX-08 and EBR-15.

Table 9-2. Chronology of Waste Area Group 6 events.

Event	Date
Construction of EBR-I was completed.	1951
Operation of the EBR-I reactor began.	August 24, 1951
The first electricity from nuclear power was generated at EBR-I.	December 20, 1951
The EBR-I scientists proved the breeder reactor concept.	1953
Construction of BORAX-I was completed.	1953
BORAX-I was intentionally destroyed.	July 1954
Construction of BORAX-II was completed.	1954
Operation of the BORAX-II reactor began.	October 19, 1954
BORAX-II operation was shut down.	March 1955
Operation of the BORAX-III reactor began.	June 9, 1955
BORAX-III became the first reactor to provide electricity to a city (i.e., Arco, Idaho).	July 17, 1955
BORAX-III was shut down.	1956
Operation of the BORAX-IV reactor began.	December 3, 1956
BORAX-IV was shut down.	June 1958
Operation of the BORAX-V reactor began.	February 9, 1962
ERB-I operations ceased.	December 30, 1963
BORAX-V was shut down.	September 1964
EBR-I was dedicated as a Registered National Historic Landmark.	August 26, 1966
EBR-I was dedicated as a National Historic Mechanical Engineering Landmark.	1979
EBR-I was dedicated as a Historic Landmark for Advances in Materials Technology.	1979
The BORAX leach pond was backfilled with clean dirt.	1985
EBR-I was dedicated as a Nuclear Historic Landmark.	1987
The *Remedial Investigation/Feasibility Study Report for Operable Units 5-05 and 6-01 (SL-1 and BORAX-I Burial Grounds)* (INEL 1995b) was completed.	March 1995
The *Engineering Evaluation/Cost Analysis for Operable Unit 10-06 Radionuclide-Contaminated Soils Removal Action at the Idaho National Engineering Laboratory* (INEL 1995a) was completed.	June 1995
The non-time-critical removal action fieldwork at BORAX-08 was completed.	September 18, 1995
The *Record of Decision Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INEL 1996a) was completed.	January 1996
The *Stationary Low Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Remedial Design/Remedial Action Scope of Work, Operable Units 5-05 and 6-01* (INEL 1996b) was completed.	March 1996
The *Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Remedial Design/Remedial Action Work Plan, Operable Unit 5-05/6-01* (DOE-ID 1996) was completed.	April 1996

Table 9-2. (continued).

Event	Date
The BORAX-V decontamination, decommissioning, removal, and containment action was completed.	May 1997
The BORAX-I remedial action was completed.	1997
The *Remedial Action Report OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers* (DOE-ID 1997) was completed.	October 1997
The *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001) was completed.	August 2001
The *Record of Decision Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04* (DOE-ID 2002) was completed.	November 2002
The *Operable Units 6-05 and 10-04, Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2003) was completed.	February 2003
The *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a) was completed.	February 2004
The *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004b) was completed.	June 2004
The *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005) was completed.	January 2005

BORAX = Boiling Water Reactor Experiment
DOE-ID = U.S. Department of Energy Idaho Operations Office
EBR = Experimental Breeder Reactor
INEEL = Idaho National Engineering and Environmental Laboratory
INEL = Idaho National Engineering Laboratory

9.1.1 Remedy Selection

9.1.1.1 BORAX-I Burial Ground (BORAX-02). In December 1995, the *Record of Decision Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INEL 1996a) was signed, requiring a selected remedy calling for containment by capping with an engineered, long-term barrier composed primarily of natural material. The ROD established action levels for Cs-137 (16.7 pCi/g), U-235 (13.2 pCi/g), and Sr-90 (10.8 pCi/g).

9.1.1.2 BORAX Ditch (BORAX-08 Site) and Radioactive Soil Contamination at EBR-I (EBR-15 Site). The 1995 CERCLA non-time-critical removal action addressed radionuclide-contaminated soil under OU 10-06 at the radioactive soil contamination site (EBR-15 site) and the BORAX ditch (BORAX-08 site), as outlined in the Engineering Evaluation/Cost Analysis for OU 10-06 (INEL 1995a). Cleanup was based on a preliminary remediation goal concentration of 16.7 pCi/g for Cs-137 (INEL 1995a).

9.1.1.3 Institutional Controls. Signed in November 2002, the *Record of Decision Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04* (DOE-ID 2002) provided for implementation of institutional controls at selected WAG 6 no-further-action sites (Figure 9-4). Institutional controls are required at four BORAX sites, because Cs-137 concentrations exceed risk-based levels for the 100-year future residential scenario. The risk at

the EBR-08 site is attributed to the presence of diesel. A brief description of the objectives of the institutional controls for each of the WAG 6 sites is provided below:

- **BORAX-II through BORAX-V Leach Pond (BORAX-01 Site)**—Prevent exposure to contaminated soil, and control land use as industrial until discontinued based on the results of a five-year review.

- **BORAX-I Burial Ground (BORAX-02 Site)**—Maintain the integrity of the containment barrier. Establish visible access restrictions, and control drilling and excavation.

- **BORAX Ditch (BORAX-08 Site)**—Prevent exposure to contaminated soil, and control land use as industrial until discontinued based on the results of a five-year review.

- **BORAX-II through BORAX-V (BORAX-09 Site)**—Maintain the integrity of the containment barrier. Establish visible access restrictions, and control drilling and excavation.

- **EBR-01 Fuel Oil Tank (EBR-08 Site)**—Prevent exposure to contaminated soil. Establish visible access restrictions, and control drilling and excavation.

The ROD (DOE-ID 2002) also mandated development of a comprehensive approach for establishing, implementing, enforcing, and monitoring institutional controls at CERCLA sites in accordance with EPA Region 10 policy (EPA 1999).

In accordance with the requirements delineated in the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a), institutional controls were implemented at the five sites listed in 2004. The results from the OU 10-04 Phase I activities are documented in the *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005).

9.1.2 Remedial Action Objectives

9.1.2.1 BORAX-I Burial Ground (BORAX-02 Site). Results of the remedial investigation and baseline risk assessment indicated that exposure to penetrating radiation from contaminated soils and materials within the burial ground presented the most significant future risk to human health. Therefore, the primary RAOs and the focus of the remedial action alternative development were to inhibit exposure to radioactive materials. The RAOs established for protection of human health were as follows:

- Inhibit exposure to radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06)

- Inhibit ingestion of radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06)

- Inhibit inhalation of suspended radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06)

- Inhibit degradation of the burial ground that could result in exposure of buried waste or migration of contaminants to the surface that would pose a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).

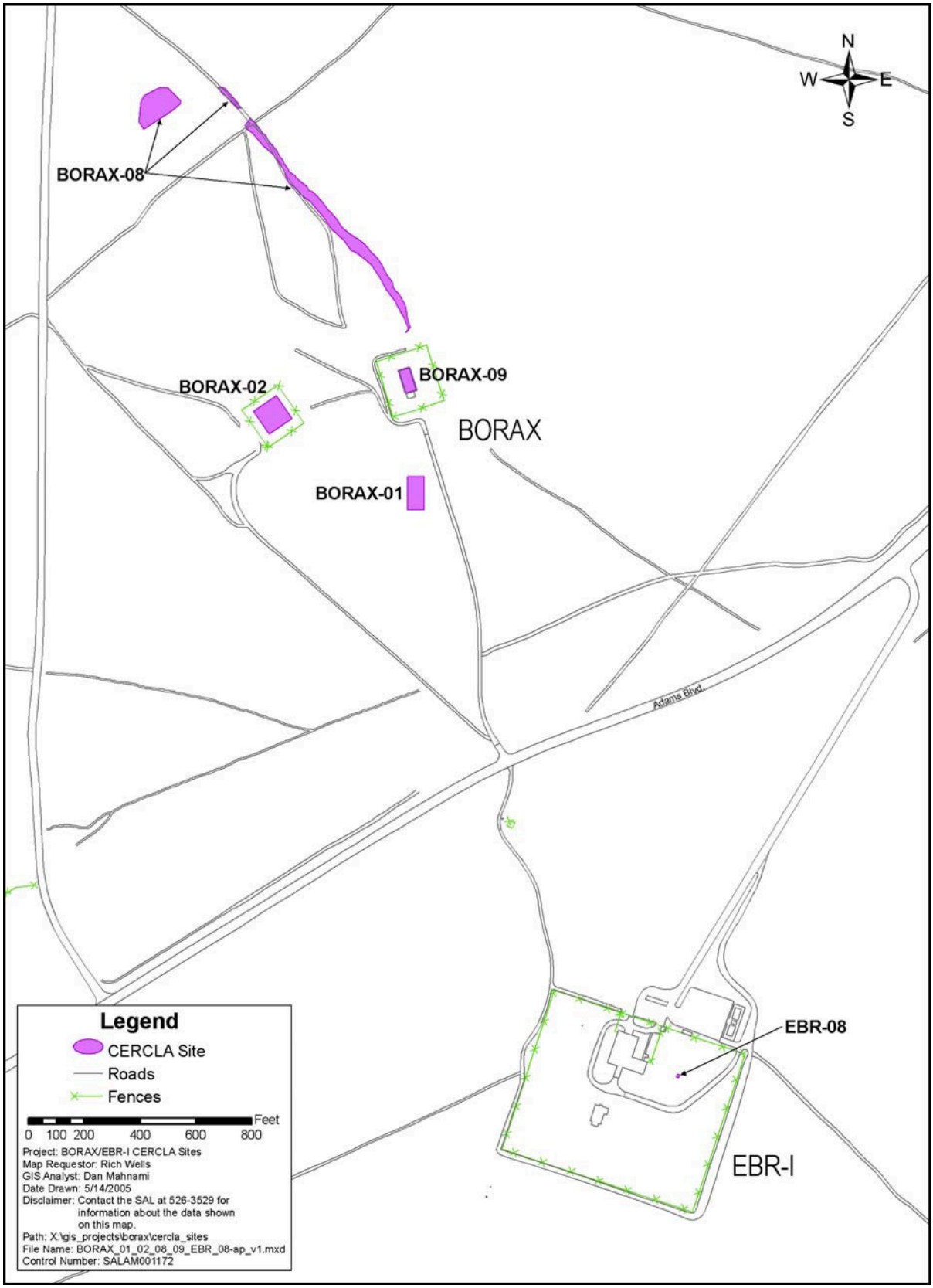

Figure 9-4. Waste Area Group 6 institutional control sites.

The RAO for protection of the environment focuses on preservation of the local ecology by inhibiting the potential for contaminant migration. The RAO established for protection of the environment was to inhibit adverse effects to resident species from exposure to contaminants at the burial ground.

9.1.2.2 BORAX Ditch (BORAX-08 Site) and Radioactive Soil Contamination at EBR-I (EBR-15 Site). The RAOs for these sites were based on the results of the human health and ecological baseline risk assessments and were specific to the COCs and exposure pathways identified for the sites. The RAOs for protecting the environment were not required for the radioactive soil contamination at EBR-I, because the area was found to be protective of the environment. The recommended RAOs are presented in Table 9-3.

Table 9-3. Remedial action objectives for the non-time-critical removal action.

Site	Environmental Media	RAO
BORAX-08	Soil	Prevent direct exposure to radiation posing excess cancer risk levels of 1E-04.
		Prevent adverse effects to resident populations (as determined by the ecological risk assessment) from soil or air containing COCs from the BORAX ditch.
		Limit release of metals from the site by migration caused by infiltrating precipitation.
		Prevent erosion that might result in the release of contaminated soils.
		Limit biotic intrusion into contaminated ditch soils that could facilitate erosion or the release of contaminated soil.
	Groundwater	Prevent ingestion of groundwater in excess of maximum contaminant levels and a total cancer risk of 1E-04 for metals only.
EBR-15	Soil	Prevent direct exposure to radiation posing excess cancer risk levels of 1E-04.
	Groundwater	Prevent ingestion of groundwater posing excess cancer risk levels of 1E-04 to 1E-06.
	Food crops	Prevent ingestion of contaminated food crops posing excess cancer risks of 1E-04 (Areas B, 7, 8, 9, 11a, and 11b).

BORAX = Boiling Water Reactor Experiment
COC = contaminant of concern
EBR = Experimental Breeder Reactor
RAO = remedial action objective

9.1.3 Remedy Implementation

9.1.3.1 BORAX-I Burial Ground (BORAX-02 Site). The remedial action for the burial ground was done in accordance with the requirements delineated in the *Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Project Remedial Design/Remedial Action Work Plan, Operable Unit 5-05/6-01* (DOE-ID 1996). The remedial action began in July 1996 with the removal of all shrubs, roots, signs, fencing, and other debris from the contaminated

area for consolidation on top of the original 100- × 100-ft burial ground. Soil areas with radionuclide contamination exceeding the action levels were excavated to a depth of 1 ft and placed over the original burial ground in 6-in. lifts. A human intrusion barrier consisting of basalt riprap was constructed over the consolidated soils. A chain-link fence was installed around the burial ground with "Keep Out" and CERCLA identification signs, and two granite monuments were installed to warn potential future intruders. Results of the remedial action are documented in the *Remedial Action Report OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers* (DOE-ID 1997).

9.1.3.2 BORAX Ditch (BORAX-08 Site) and Radioactive Soil Contamination at EBR-I (EBR-15 Site).

The total volume of soil excavated from the EBR-15 site was 1,280 yd^3 with an average excavation depth of 12.5 in. The radionuclide-contaminated soil was transported in covered dump trucks to the RTC (formerly the TRA) warm waste pond for disposal. The total volume excavated from the BORAX-08 site was 1,180 yd^3, focusing on Cs-137 as the COC with a preliminary remediation goal of 16.7 pCi/g. Again, the radionuclide-contaminated soil was disposed of in the RTC warm waste pond.

9.2 Data Evaluation

9.2.1 Site Inspections

Operations, maintenance, and institutional control inspections are conducted annually at WAG 6 sites. The following paragraphs summarize the results of annual inspections conducted at WAG 6 within the timeframe of this five-year review.

Inspections of institutional controls were required within 6 months of the ROD being signed and were completed in March 2003 (INEEL 2003). No deficiencies were identified during the 2003 inspection; however, all five sites were posted with "Environmentally Controlled Area" signs, which needed to be replaced with the standardized institutional controls sign. Signs were replaced during the spring of 2004. Institutional control inspections were conducted again in June 2004 (DOE-ID 2004c). Visible access restrictions, activity control, and land-use restrictions were evaluated, and no deficiencies were identified.

Operations and maintenance activities at WAG 6 consist of annual inspections of the BORAX-02 site for evidence of intrusion, settling, erosion, and, at the perimeter of the covers, radioactive contaminant migration. Annual inspections showed that the engineered covers are functioning as designed with no sign of erosion, subsidence, or animal intrusion.

9.2.2 BORAX-I Burial Ground (BORAX-02 Site)

The Cs-137 analytical results for the excavated areas had a mean of 1.43 pCi/g with a 95% UCL of 7.2 pCi/g based on a gamma distribution of the data. Only one of the zones requiring excavation exceeded the remediation goal for U-235 with a concentration of 15 pCi/g. After excavation, the maximum concentration was 8.2 pCi/g. The Sr-90 concentrations for the excavated areas ranged from 0.9 to 85 pCi/g with an average of 12.4 pCi/g and a median of 1.3 pCi/g. The 95% Chebyshev UCL for the Sr-90 data set is 52.2 pCi/g, which exceeds the remediation goal. The data set is largely skewed because of the single high data point of 85 pCi/g. If this point is omitted from consideration, the minimum remains 0.9 pCi/g with a maximum of 8.1 pCi/g, an average of 3.35 pCi/g, and a median of 1.25 pCi/g. The 95% Chebyshev UCL for this modified data set is 8.23 pCi/g, which is within the specified remediation goal.

9.2.3 BORAX Ditch (BORAX-08 Site)

Based on the verification sampling data provided in the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001), the residual Cs-137 concentrations at the BORAX-08 site ranged from 0.1 to 8.1 pCi/g with an average concentration of 1.2 pCi/g and a 95% UCL concentration of 2.75 pCi/g based on a gamma distribution for the data set. Based on the revised preliminary remediation goals as provided by the EPA and presented in Appendix A, the Cs-137 concentration required for free release is 5.97 pCi/g. Therefore, institutional controls should no longer be required at BORAX-08.

9.3 Progress since Last Review

The BORAX-I burial ground (BORAX-02 site) is the only WAG 6 site to previously undergo a five-year review, which was conducted by the EPA (EPA 2001). The 1998 annual inspection report identified localized areas of potential contamination that were observed during the radiological survey of the area. Potential contamination of the burial ground was addressed in the WAG 10 RI/FS (DOE-ID 2001), which did not confirm the potential contamination identified in the 1998 annual inspection report. The review showed that based on the most recent annual inspection, the engineered barrier appeared to be intact with no visible evidence of subsidence or erosion. There was no indication that weeds or shrubs were encroaching onto the engineered barrier and no indication of other biointrusion. The revegetated area showed no indication of soil movement or erosion, and the grass appeared to be well established. Results of radiological surveys were consistent with those obtained historically after the remedial action. The EPA staff visually inspected the site on July 16, 2001, and observations were consistent with the annual report.

9.3.1 Issues Identified during the First Five-Year Review

The first five-year review report noted that according to the June 2001 annual inspection, the CERCLA sign at the BORAX-02 site needed to be updated to correctly state the existing dimensions of the perimeter fence. It was recommended that the next review for the site be coordinated with the next statutory Sitewide five-year review. It was also noted that the observation of contamination at the burial ground so soon after completion of the remedial action was cause for concern, but there was no indication of failure of the engineered barrier. The early appearance of contamination, the proximity of exposed surface contamination areas, and the fact that the radiological surveys were similar from year to year suggested windblown cross contamination as a likely source of the observed contamination.

9.3.2 Response Actions to Issues Identified during the First Five-Year Review

The only issue identified in the first five-year review requiring attention was to replace the CERCLA sign with an updated version. As part of the OU 6-05 and 10-04 Phase I remedial action, the CERCLA sign was replaced to comply with the current specifications in the *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004b). That action was documented in the *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005).

It was also determined that the residual risk associated with the site needed to be addressed, although it was not required as a result of the first five-year review of the burial ground (BORAX-02 site) remedial action. As discussed in the 2002 annual inspection report, BORAX-02 was assessed for the nature and extent of the radiological contamination that remain outside the engineered barrier at the site. Upon review of the available data, the data from the 1998 Global Positioning Radiometric Scanner survey were selected for use in the risk assessment. The Cs-137 data were corrected for the shielding provided by the 6-in. gravel layer and for radioactive decay to May 2002. Historical data were used to establish ratios

of Sr-90 and U-235 to Cs-137 in order to estimate the concentrations of the two isotopes. Based on this approach, the average Cs-137, U-235, and Sr-90 concentrations for the site using exposure point concentrations for nine discrete areas were 51.56 pCi/g, 2.98 pCi/g, and 12.57 pCi/g, respectively.

The assessment was performed using two methods, the RESidual RADioactivity (RESRAD) modeling and the standard baseline risk assessment methodology presented in the OU 10-04 RI/FS (DOE-ID 2001). The results of the assessment showed that the dose to current and future receptors is acceptable at the BORAX-02 site, although two areas of contamination might exceed risk-based concentrations (1E-04). This risk, however, is considered acceptable based on the uncertainties associated with the analysis and combined with the understanding that the residual Cs-137 activity at the site will decay to acceptable risk levels in approximately 130 years.

9.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

The Cs-137 and U-235 confirmation sample results for the BORAX-02 site remediated under OU 6-01 were within the specified remediation goals, but the Sr-90 results are questionable because of the single high result. The site does not pose an unacceptable risk to human health or the environment, given the results of the risk assessment performed in 2002 to address residual contamination at the site (EDF-2208). Disregarding the single high result for SR-90, the 95% UCL for Sr-90 was 8.23 pCi/g, which is within the remediation goal of 10.8 pCi/g. The engineered cover is intended to provide shielding from ionizing radiation, prevent human intrusion, and contain the contaminated surface soils. The annual inspections validated the structural integrity of the cover. Based on this five-year review, the remedy and protective measures implemented at the BORAX-I burial ground (BORAX-02 site) are functioning as intended.

The OU 6-05 ROD (DOE-ID 2002) required implementation of institutional controls at five sites. Based on this five-year review, the institutional controls are in place and functioning as required.

The non-time-critical removal actions completed at the EBR-15 and BORAX-08 sites were successful in removing contaminated soil that exceeded the prescribed remediation goals. For the two sites, the 95% UCL for the residual Cs-137 contamination was 3.17 pCi/g and 2.75 pCi/g, respectively, as compared to the remediation goal of 16.7 pCi/g. Based on these concentrations, the remediation of the two sites was successful.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

None of the COCs has undergone any major revision in the toxicological criteria since the development of the final remediation goals that would decrease these goals. In fact, based on the EPA guidance of 2001 as presented in Appendix A, the Cs-137 remediation goals have increased. Therefore, once met, the final remediation goals (site-specific, risk-based cleanup levels) will remain protective of human health and the environment under current exposure scenarios.

The original assumptions, cleanup levels, and RAOs used at the time of the remedy selection are still valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No new information that would call into question the protectiveness of the implemented remedies has surfaced while compiling and reviewing the inspections, radiological survey, and confirmation sampling analytical data.

9.5 Technical Assessment Summary

Remedial actions have been completed at the BORAX-I burial ground, the BORAX ditch, and the radioactive soil contamination area at EBR-I. Based on the available data, the remedial actions at the sites were successful, and the remedies are functioning as intended. The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selections are still valid, and no new information has come to light that could call into question the protectiveness of the remedies. In addition to the remediation of these three sites, institutional controls have been implemented and are functioning as required at five sites within WAG 6.

9.6 Issues

No issues were identified during the five-year review of the remedial actions conducted at WAG 6. For a list of issues identified within all WAGs during the INL Sitewide five-year review in 2005, see Table C-1 in Appendix C.

9.7 Recommendations and Follow-up Actions

The annual inspections and reports of institutional controls should be continued in accordance with the 1999 EPA "Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities" (EPA 1999), as outlined in the *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004b). Radiological surveys at the BORAX-I burial ground should be continued to ensure that contamination levels are at or below those observed historically. If any changes are identified that would call into question the integrity of the engineered barrier at the burial ground, a new baseline survey should be completed to identify the impact of the changes. Based on the preliminary remediation goals provided by the EPA (see Appendix A), institutional controls are no longer required at BORAX-08.

9.8 Protectiveness Statement

The remedies completed at WAG 6 are functioning as intended. The physical conditions of the site have not changed in ways that would affect the protectiveness of the completed remedies, nor have the toxicity or risk factors changed in ways that would adversely impact the levels of COCs. There is no information that would call into question the protectiveness of the remedies performed.

9.9 Section 9 References

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10. WASTE AREA GROUP 7 (RADIOACTIVE WASTE MANAGEMENT COMPLEX)

Since it began operations in the 1950s, the RWMC has been used to dispose of hazardous and radioactive waste. The RWMC occupies about 177 acres and is divided into three areas: the SDA, the Transuranic Storage Area, and the administration and operations area. This five-year review of the RWMC addresses only cleanup sites within the SDA, which consists of a series of pits and trenches designed for disposal of mixed hazardous substances, including organic waste (e.g., carbon tetrachloride [CCl_4]) and radioactive waste (e.g., transuranic [TRU] waste). The SDA was used to dispose of TRU waste from 1952 to 1970. Disposal of mixed waste was discontinued in 1983.

To facilitate the cleanup of the RWMC, it was designated as WAG 7 under the FFA/CO (DOE-ID 1991). Final remedial actions are being implemented at two OUs within the SDA: OU 7-08 (which consists of organic contamination in the vadose zone [OCVZ]) and OU 7-12 (which consists of Pad A). In addition, an interim action that is subject to a five-year review is being implemented at OU 7-10 (which consists of Pit 9). Figure 10-1 shows the locations of these OUs.

10.1 Operable Unit 7-08 (Organic Contamination in the Vadose Zone)

From 1954 to 1970, drums of radioactive and organic waste from the Rocky Flats Plant in Colorado were buried in the SDA. Many of these containers have since breached, releasing VOCs to the vadose zone, which is the 580-ft-thick unsaturated zone that lies beneath the earth's surface but above the SRPA. These VOCs are primarily in the form of organic vapors that have migrated from the buried waste.

Cleanup of the OCVZ at the SDA is being addressed under OU 7-08. This remedial action is proceeding in accordance with the *Record of Decision Declaration for Organic Contamination in the Vadose Zone, Operable Unit 7-08, Idaho National Engineering Laboratory, Radioactive Waste Management Area, Subsurface Disposal Area* (DOE-ID 1994a). Table 10-1 shows the COCs and cleanup goals for the OCVZ.

The OU 7-08 ROD (DOE-ID 1994a) lists CCl_4, PCE, TCE, and 1,1,1-TCA as COCs but only lists a cleanup goal for CCl_4, because successful treatment of CCl_4 will also reduce the other COCs. The original estimated volume of CCl_4 buried in the SDA was 325,000 lb, but that estimate was revised to 1,800,000 lb in the spring of 2001 based on additional information obtained from the Rocky Flats Plant.

CCl_4 has been detected in the SDA surficial sediments, vadose zone soil gas, vadose zone soil water (perched water and lysimeters), and the SRPA beneath and surrounding the SDA. Through the use of surface isolation flux chambers, CCl_4 vapor has been detected emanating from the soil surface. In 1987, CCl_4 was also detected in the SRPA above MCLs.

Since 1996, treatment units have been used to destroy contaminants in vapor extracted from various wells in the vadose zone. Early units used recuperative flameless thermal oxidation (RFTO) to destroy VOCs. Newer OCVZ units utilize catalytic oxidation. Monitoring indicates that concentrations of VOCs are decreasing throughout the vadose zone.

Table 10-2 provides a chronology of significant events at OU 7-08.

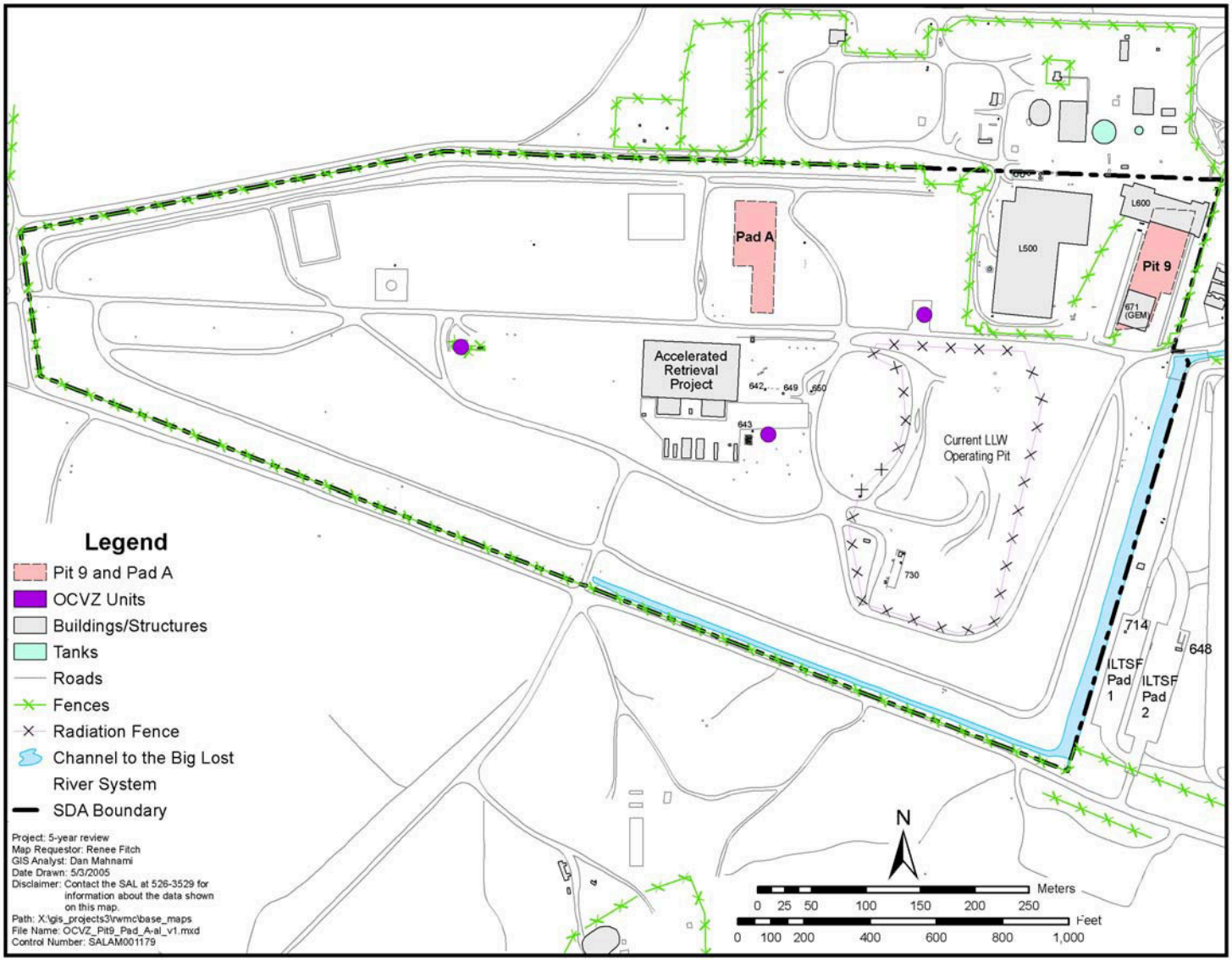

Figure 10-1. Location of Operable Unit 7-08 (organic contamination in the vadose zone units), Operable Unit 7-10 (Pit 9), and Operable Unit 7-12 (Pad A) at the Radioactive Waste Management Complex.

Table 10-1. Contaminants of concern at Operable Unit 7-08.

Site	COCs	Cleanup Goals[a]
OCVZ	Carbon tetrachloride (CCl_4)	30 to 200 ppm by vapor
	PCE	NA[a]
	TCE	NA[a]
	1,1,1-TCA	NA[a]

a. The OU 7-08 ROD (DOE-ID 1994a) does not specify cleanup goals for PCE, TCE, or 1,1,1-TCA, because these contaminants will be reduced by virtue of CCl_4 treatment. Cleanup goals are being revised and will be published in Revision 2 of the *Data Quality Objectives Summary Report for Operable Unit 7-08 Post-Record of Decision Sampling* (INEEL 2002).

COC = contaminant of concern
DOE-ID = U.S. Department of Energy Idaho Operations Office
INEEL = Idaho National Engineering and Environmental Laboratory
NA = not applicable
OCVZ = organic contamination in the vadose zone
OU = operable unit
PCE = tetrachloroethene
ppm = parts per million
ROD = Record of Decision
TCA = trichloroethane
TCE = trichloroethene

Table 10-2. Chronology of Operable Unit 7-08 events.

Event	Date
The RWMC was established.	1950
The TRU waste was buried at the SDA. Associated with the TRU waste were large quantities of VOCs.	1952–1970
A shallow gas survey identified VOCs in the subsurface.	1987
CCl_4 was detected above the MCL in the SRPA south of the SDA.	1987
The INL Site received its final listing on the National Priorities List (54 FR 29820).	November 21, 1991
The FFA/CO for the INL Site was signed (DOE-ID 1991).	December 9, 1991
Subsurface vapor samples from monitoring wells at the RWMC revealed the extent and concentration of contaminants in the subsurface.	July 1992–March 1993
The remedial action and feasibility study was completed for OCVZ.	1993
The OU 7-08 ROD (DOE-ID 1994a) was signed.	December 2, 1994
The prefinal inspection of the RFTO units was completed.	December 1995
The baseline subsurface vapor sampling was completed.	January 4, 1996
RFTO Units A, B, and C were started.	January 1996
The first failure of RFTO Unit C occurred. The unit was rebuilt.	September 1998
The final failure of RFTO Unit C occurred.	May 14, 2000
The inventory of VOCs was revised upward.	2001
Catalytic oxidation Unit D replaced RFTO Unit C.	July 2001

Table 10-2. (continued).

Event	Date
Unit D began continuous operation.	January 2002
The first five-year review of the OCVZ remedy was completed.	August 18, 2003
Unit B was replaced with catalytic oxidation Unit F.	March 2004
Unit A was replaced with catalytic oxidation Unit E.	April 2004
Unit E was relocated.	March 2005

DOE-ID = U.S. Department of Energy Idaho Operations Office
FFA/CO = Federal Facility Agreement and Consent Order
FR = *Federal Register*
INL = Idaho National Laboratory
MCL = maximum contaminant level
OCVZ = organic contamination in the vadose zone
OU = operable unit
RFTO = recuperative flameless thermal oxidation
ROD = Record of Decision
RWMC = Radioactive Waste Management Complex
SDA = Subsurface Disposal Area
SRPA = Snake River Plain Aquifer
TRU = transuranic
VOC = volatile organic compound

10.1.1 Remedial Actions

10.1.1.1 Remedy Selection. The OU 7-08 ROD (DOE-ID 1994a) summarized the site assessment and identified the selected remedy—i.e., extraction from and destruction of organic contaminants in the vadose zone beneath and in the immediate vicinity of the RWMC where organic contaminants exist in a vapor state. The selected remedy does not include the waste remaining in the disposal pits. The selected remedy that is specified in the OU 7-08 ROD also includes monitoring of the vadose zone vapor and the SRPA.

The general objective of the selected remedy was to reduce the risks posed to human health and the environment from organic contaminants in the vadose zone and to prevent federal and state drinking water standards from being exceeded after the 100-year institutional control period, as defined in DOE Manual 435.1-1, "Radioactive Waste Management Manual."

The OU 7-08 ROD (DOE-ID 1994a) stated that the major components of the selected remedy would include the following:

- Installing and operating five vapor extraction wells (in addition to an existing vapor extraction well) at the RWMC as part of a first-phase effort to extract organic contaminant vapors from the vadose zone. The selected remedy includes options to expand the number of vapor extraction wells for potential second and third phases. Additional system modifications will be evaluated with each transition phase.

- Installing and operating off-gas treatment systems to destroy the organic contaminants in the vapor that is removed from the extraction wells. Off-gas treatment will be in the form of catalytic oxidation or an equally effective organic contaminant destruction technology.

- The addition of soil vapor monitoring wells to monitor the performance of the vapor extraction wells and verify the attainment of RAOs. Soil vapor monitoring will also provide information to evaluate potential modifications to the selected remedy to continue beyond the first phase. The

expected duration of the first phase is approximately 2 years; potential second and third phases would operate for approximately 2 years each. The actual duration of each phase is dependent on elements such as equipment procurement and installation that may be involved with each potential phase transition.

- The maintenance of institutional controls, which includes using signs, restricting access, maintaining fences/barriers, and monitoring the existing production well supplying water to workers at the RWMC. It is presumed that this level of institutional control will be maintained at the RWMC through the year 2091.

The OU 7-08 ROD (DOE-ID 1994a) also stated that organic waste remaining in the pits could extend the time needed to achieve RAOs using the selected remedy, because the remaining organic waste could act as a "long-term" source of OCVZ. Once the remedy was implemented, it became apparent that the "phases" would last more than 2 years, because the remedy does not include removal or treatment of the buried waste. Removal or treatment of the remaining buried organic waste, which is the long-term source of the contamination, could reduce the time needed to reach remediation goals using the current OCVZ system. In 2004, the Accelerated Retrieval Project (Figure 10-1) began limited excavation and retrieval of selected waste streams from a designated area in the SDA—a 1/2-acre plot in the eastern portion of the SDA's Pit 4. The OCVZ Project, though not directly affiliated with the Accelerated Retrieval Project, will benefit by the reduction of the organic source term in the SDA.

10.1.1.2 Remedial Action Objectives. The OU 7-08 ROD (DOE-ID 1994a) concluded that extraction and destruction of organic vapors from the vadose zone beneath the SDA would reduce direct exposure to the contaminants. Although the OU 7-08 ROD specifies cleanup goals for vapor in the vadose zone and does not specifically address cleanup of the SRPA, the objective of this remedial action is to prevent the migration of contaminants to the SRPA and keep them below federal and state MCLs after a 100-year period. The MCLs for the various organic compounds are the preliminary remediation goals for protection of the SRPA, which will be addressed in the OU 7-14 ROD. The OCVZ remedial action ensures protection of human health and the environment. The decision to implement this remedial action was based on the results of human-health and ecological-risk assessments.

10.1.1.3 Remedy Implementation. To implement the selected remedy described in the OU 7-08 ROD (DOE-ID 1994a), three RFTO units were installed within the SDA (Wilkening 2003). Operation of the RFTO units began in 1996. Units A and B were designed to extract and treat vapors from two wells each. Unit C was designed to extract and treat vapors from one well. During the spring of 2001, Unit C was decommissioned and removed from the SDA. Unit D—an electrically heated catalytic oxidizer—was installed at the previous Unit C location, began operating in July 2001, and was brought up to full-scale operation in March 2002. In February 2003, Unit B was decommissioned followed by Unit A in late September 2003. Units E and F, both electrically heated catalytic oxidizers, replaced Units A and B and became operational during the spring of 2004. On January 6, 2004, Unit F was started for testing and began full-scale operation on March 15, 2004. Unit E was started for testing on March 23, 2004, and began full-scale operation on April 6, 2004.

In 2000 and 2001, four wells were installed inside the SDA to support OU 7-08. These wells include a groundwater monitoring well, M17S, and three vapor extraction wells: DE1 (~480 ft bls), 7E (~110 ft bls), and 6E (~110 ft bls). Well DE1 also provides vapor monitoring.

Fourteen new wells were installed during 2002 and 2003 to support the OU 7-08 remedial action. These wells were completed as vapor extraction wells or as a combination of monitoring and extraction wells. The locations of the wells are shown in Figure 10-2. They were installed in clusters of three wells, one well having a shallow extraction (SE) interval located above the B-C interbed (i.e., ~110 ft bls),

one well having an intermediate extraction (IE) interval located between the B-C interbed (i.e., ~110 ft bls) and the C-D interbed (i.e., ~240 ft bls), and one well having a deep extraction (DE) interval located below the C-D interbed (i.e., ~240 ft bls). The new wells—SE3, IE3, DE3, IE4, DE4, SE6, IE6, DE6, SE7, IE7, DE7, SE8, IE8, and DE8—were installed in five distinct locations based primarily on proximity to buried organic waste.

Vapor sampling occurs at 174 monitoring ports (Figure 10-2). Monthly sampling is conducted at 141 of these monitoring ports, and all 174 monitoring ports are sampled quarterly. Vapor is being extracted from the vadose zone at the SDA and treated at 20 extraction wells. Table 10-3 shows the contaminants removed from the vadose zone as of the end of 2004.

10.1.2 Data Evaluation

As mentioned above, the OU 7-08 ROD (DOE-ID 1994a) addresses cleanup of the vadose zone rather than contaminants in the SRPA. However, the ROD does require groundwater sampling, because such sampling indicates the effectiveness of the OCVZ Project in containing and removing contamination before it reaches the SRPA.

Data from a number of monitoring wells in the RWMC area were reviewed for VOC concentrations in groundwater. CCl_4 is the most common VOC detected in the groundwater samples over the past 5 years with consistent positive detections in approximately half of the monitoring wells in the monitoring network. Several wells are currently near or above the MCL of 5 µg/L; these wells include M7S, M16S, A11A31, and the RWMC production well. Detections of other VOC contaminants in the monitoring wells are much less frequent with occasional detections of TCE (in the RWMC production well at 0.3 µg/L in 2003) and methylene chloride (in the M1S well in 2002 and in the associated blank). All positive detections of these contaminants were well below their respective MCLs. Aquifer water samples collected at the RWMC are analyzed for other VOCs in addition to CCl_4, PCE, and methylene chloride; most of the samples were nondetections in FY 2003. Chloroform, TCE, toluene, and 1,1,1-TCA were the only compounds detected at concentrations above the quantitation limit (WAG 7) or minimum reporting level (USGS). All compounds were below the respective MCLs. Samples were analyzed for 54 other organic compounds, but none of them was detected above the quantitation limit (WAG 7) or minimum reporting level (USGS).

Figure 10-3 shows the concentration history of CCl_4 in aquifer wells in the vicinity of the RWMC. The following observations can be made by comparing the time trends in the concentration data spatially:

- A few of the wells northeast of the RWMC exhibit a generally persistent increasing concentration trend. These wells are M7S, USGS-87, and the RWMC production well. Since approximately 1997, however, the data indicate a decline in the rate of increase in M7S and the RWMC production well. USGS-90 showed an increasing concentration trend until it was last sampled in April 1999, after which the pump became inoperable. Because USGS-90 has not been sampled since that time, further trends cannot be observed in the well. Data from other wells might also be interpreted as showing increasing concentrations of CCl_4 but to a much lesser extent than the wells discussed previously. Wells with possible increasing concentrations include M3S, M15S, and M16S, whose data are either highly variable or of short duration.

- Wells to the southwest generally show flat or decreasing concentration trends. CCl_4 is not routinely detected in most of the wells in this area; these wells include M1S, OW-2, USGS-89, USGS-117, and USGS-119. Several other wells, including M6S and USGS-88, show either flat or decreasing trends.

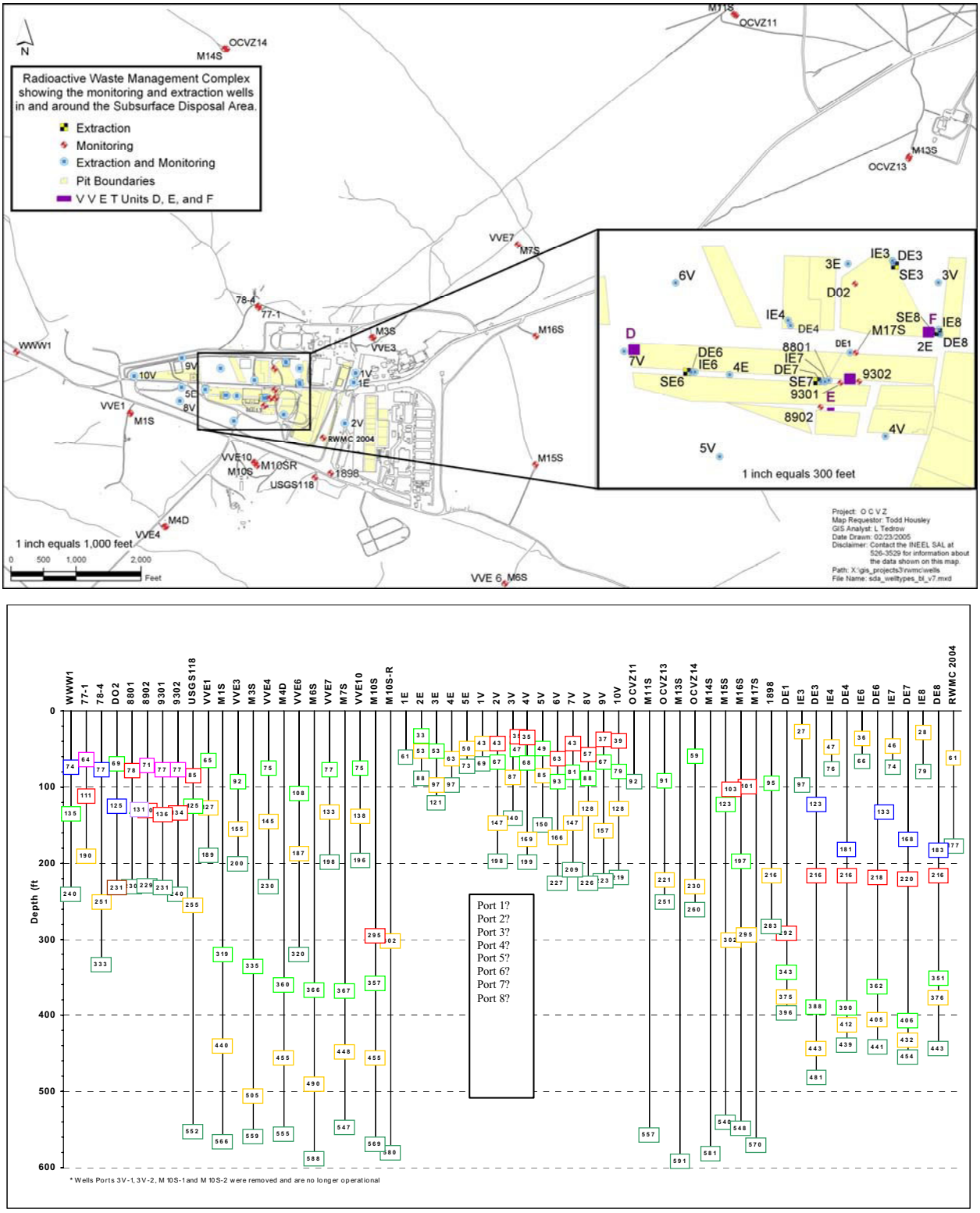

Figure 10-2. Location and depth of vapor sampling ports in and around the Subsurface Disposal Area.

Table 10-3. Breakdown by operating cycle of the mass of contaminants removed to date.

Operating Period	Year	$CHCl_3$ (lb)	TCA (lb)	PCE (lb)	TCE (lb)	CCl_4 (lb)	Total (lb)
1st 8 weeks	1996	1,001	277	183	855	4,447	6,763
% of total		15%	4%	3%	13%	66%	
2nd 8 weeks	1996	671	209	168	646	3,090	4,784
% of total		14%	4%	4%	14%	65%	
3rd 8 weeks	1996	501	149	104	449	2,211	3,413
% of total		15%	4%	3%	13%	65%	
1st quarter	1997	443	108	62	320	1,938	2,871
% of total		15%	4%	2%	11%	68%	
2nd quarter	1997	1,078	360	294	1,076	5,191	7,999
% of total		13%	5%	4%	13%	65%	
3rd quarter	1997	643	119	145	604	2,800	4,311
% of total		15%	3%	3%	14%	65%	
4th quarter	1997	1,202	342	241	987	5,391	8,162
% of total		15%	4%	3%	12%	66%	
Mid-Year	1998	1,083	339	247	967	4,757	7,393
% of total		15%	5%	3%	13%	64%	
End-Year	1998	1,452	376	412	1,537	5,942	9,719
% of total		15%	4%	4%	16%	61%	
Mid-Year	1999	745	196	149	808	3,725	5,622
% of total		13%	3%	3%	14%	66%	
End-Year	1999	1,149	367	320	1,337	5,492	8,664
% of total		13%	4%	4%	15%	63%	
Mid-Year	2000	1,125	302	272	1,252	5,119	8,072
% of total		14%	4%	3%	16%	63%	
End-Year	2000	630	128	69	567	2,934	4,329
% of total		15%	3%	2%	13%	68%	
Mid-Year	2001	1,534	272	326	1,349	6,153	9,634
% of total		16%	3%	3%	14%	64%	
End-Year	2001	1,720	513	332	1,849	7,349	11,763
% of total		15%	4%	3%	16%	62%	
Mid-Year	2002	2,061	966	517	2,377	7,845	13,767
% of total		15%	7%	4%	17%	57%	
End-Year	2002	2,412	1,016	535	2,516	8,477	14,956
% of total		16%	7%	4%	17%	57%	

Table 10-3. (continued).

Operating Period	Year	$CHCl_3$ (lb)	TCA (lb)	PCE (lb)	TCE (lb)	CCl_4 (lb)	Total (lb)
Mid-Year	2003	2,134	975	603	2,379	8,151	14,242
% of total		15%	7%	4%	17%	57%	
End-Year	2003	765	290	164	740	2,388	4,347
% of total		18%	7%	4%	17%	55%	
Mid-Year	2004	3,495	1,384	745	3,505	12,356	21,486
% of total		16%	6%	3%	16%	58%	
End-Year	2004	3,180	1,230	1,062	3,042	10,919	19,433
% of total		16%	6%	5%	16%	56%	
						Total 1996–2004	191,730

PCE = tetrachloroethene
TCA = trichloroethane
TCE = trichloroethene

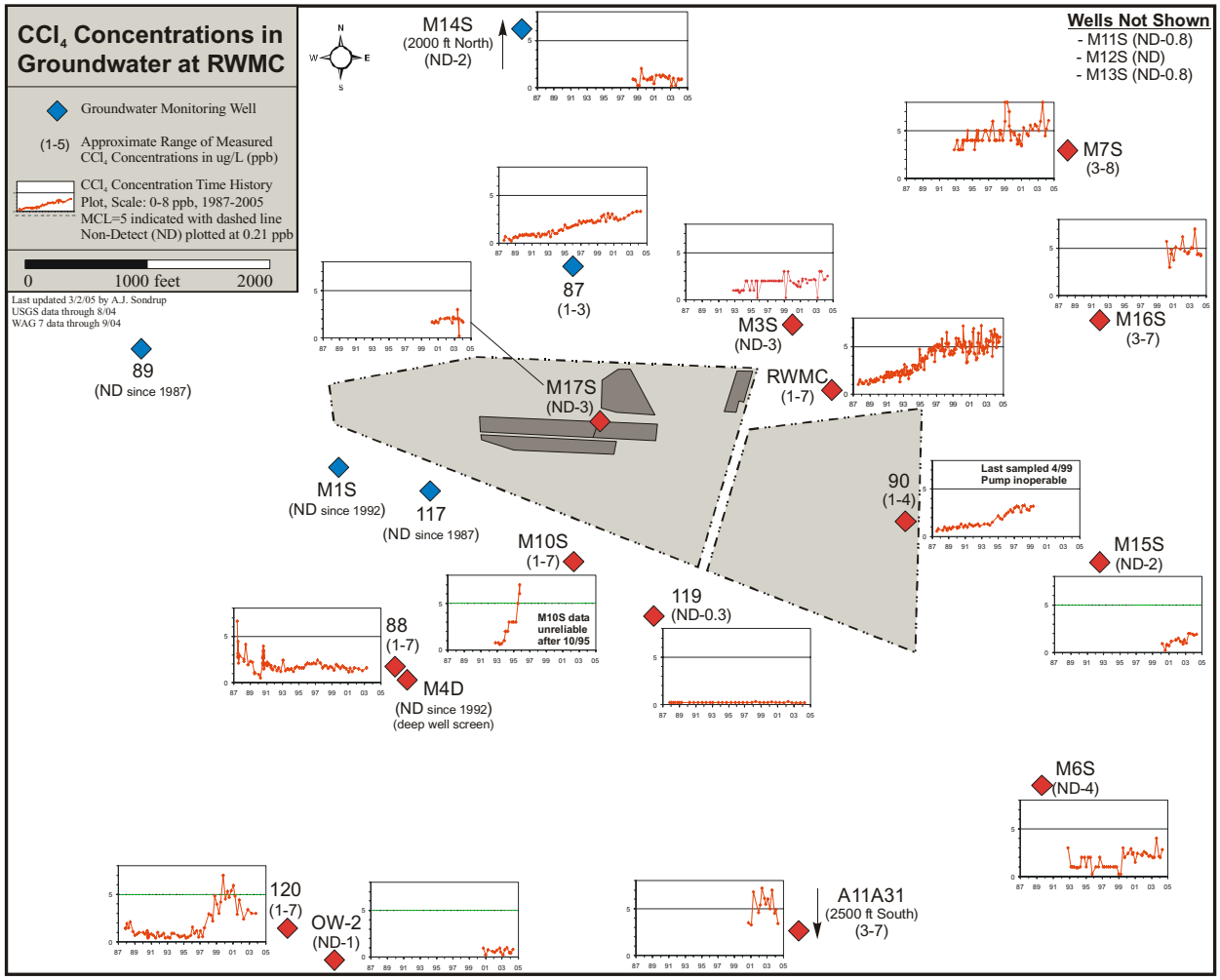

Figure 10-3. CCl_4 concentrations in aquifer monitoring wells in the vicinity of the Radioactive Waste Management Complex.

- The USGS-120 and A11A31 wells—located approximately 4,000 and 5,000 ft south of the RWMC, respectively—require a separate discussion. CCl_4 concentrations in USGS-120 were less than 2 ppb from 1987 to 1997. Then, from 1997 to 1999, the concentrations increased slightly above the MCL and remained as such for 2 years. Since 2001, however, the concentrations have decreased and are currently at about 3 ppb. Concentrations in the A11A31 well have regularly been above the MCL since approximately 2001, but results from the last three quarters have been below the MCL. The considerable distance to both of these wells from the RWMC area and the consistent positive detections of CCl_4 make estimating the total extent of contamination in the SRPA difficult. Sitewide (i.e., WAG 10) groundwater monitoring conducted has not detected CCl_4 in the southern boundary wells (USGS-009, USGS-015, and USGS-109) using standard analysis techniques.

10.1.3 Progress since Last Review

Since the last five-year review (i.e., 2003), additional wells have been installed, the reliability of the treatment units has improved, downtime has been reduced, and data acquisition in deeper zones has improved. In addition, the *Operations and Maintenance Plan for the OU 7-08 Organic Contamination in the Vadose Zone Project* (INEEL 2004) has been revised, improving the monitoring of exhaust gases.

The mass of total VOCs removed each year increased significantly in 2004 (Figure 10-4) after a period of decommissioning and installation of new units—activities that consumed much of 2003. The VOC concentrations of samples taken from ports on the inlet lines (downstream of the ambient air intake valves) to the OCVZ units were used to calculate mass removal rates. Samples have been taken daily during the normal operations workweek (i.e., Monday through Thursday), and the results are averaged between sampling events. Actual operating hours and average unit operation parameters (i.e., flow rate, pressure, and temperature) were used for the mass removal calculations (EDF-2157). Results show that approximately 192,000 lb of total VOCs has been removed from the SDA during the period from January 1996 through December 2004.

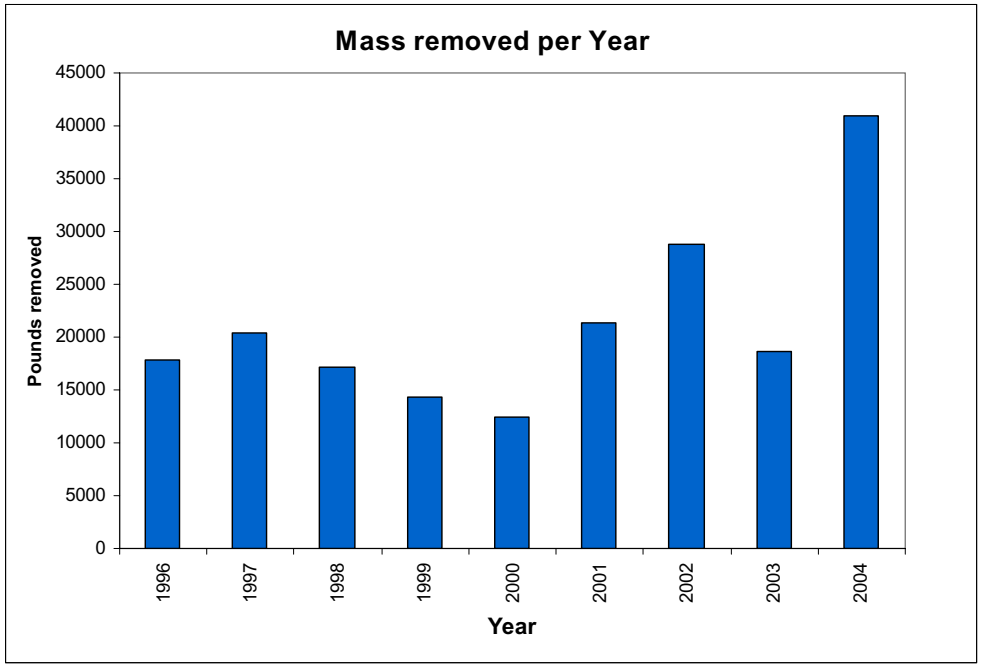

Figure 10-4. Total mass of volatile organic compounds removed during each year of organic contamination in the vadose zone operation.

In general, CCl_4 concentrations in the monitoring wells are decreasing (Figures 10-5 through 10-13). The sampling events range in time from before the remedial action started in 1996 through 2004. CCl_4 is the largest contributor to the mass removal of VOCs with 61% of the total. General trends show a decreasing areal extent of the plume of VOCs. The prevailing long-term trends indicate that overall VOC concentrations are decreasing above the B-C interbed (i.e., ~110 ft bls) when compared to data collected at the same depth before operations.

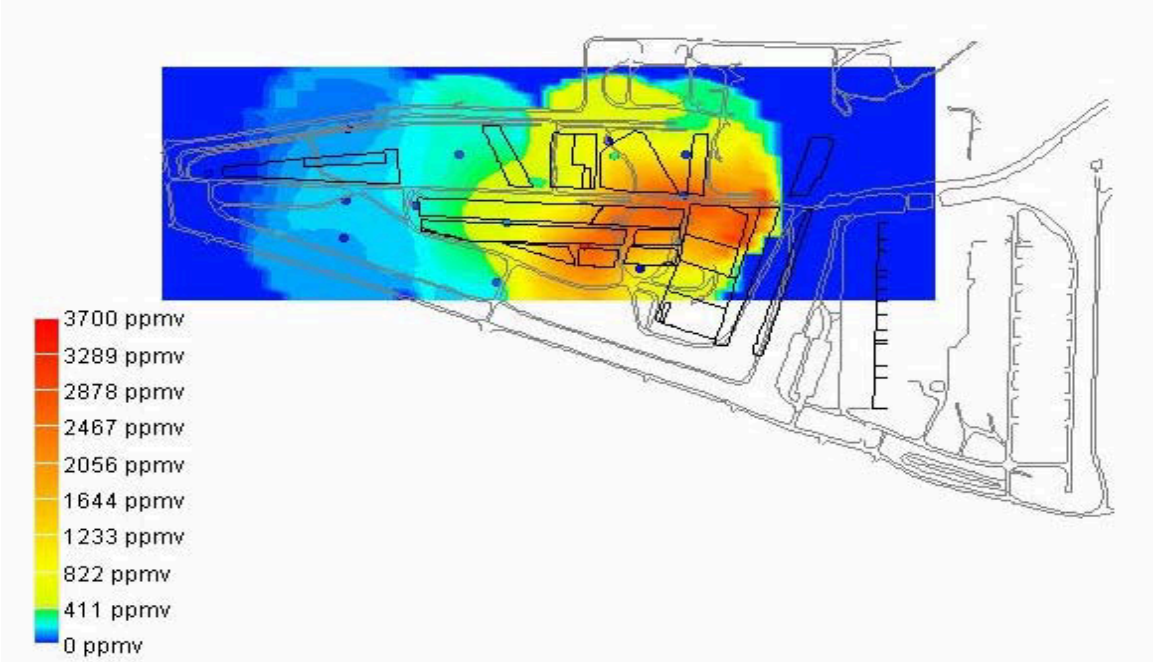

Figure 10-5. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in January 1996 (ICP 2004).

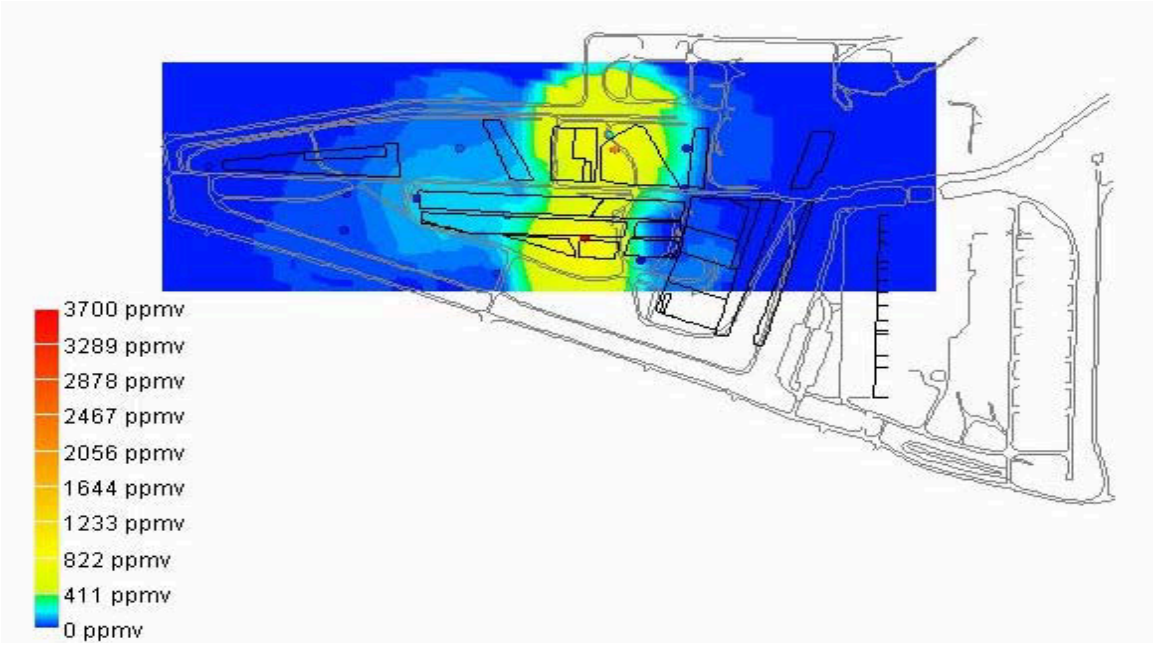

Figure 10-6. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in January 1998 (ICP 2004).

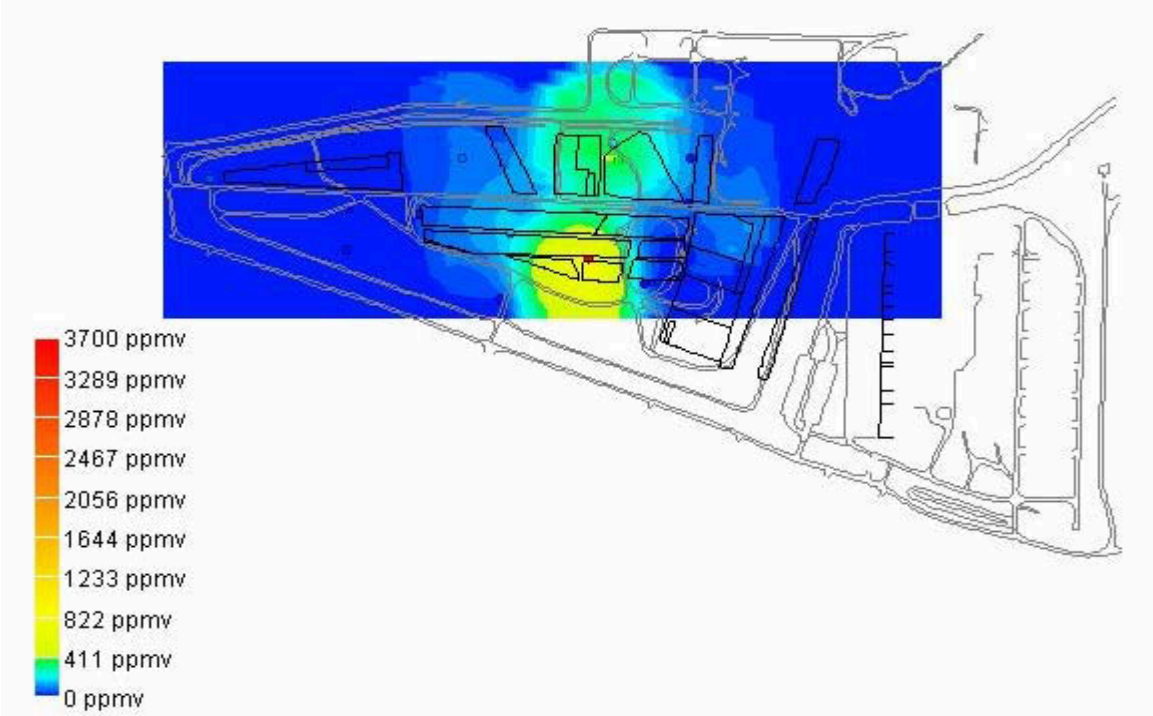

Figure 10-7. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in January 2000 (ICP 2004).

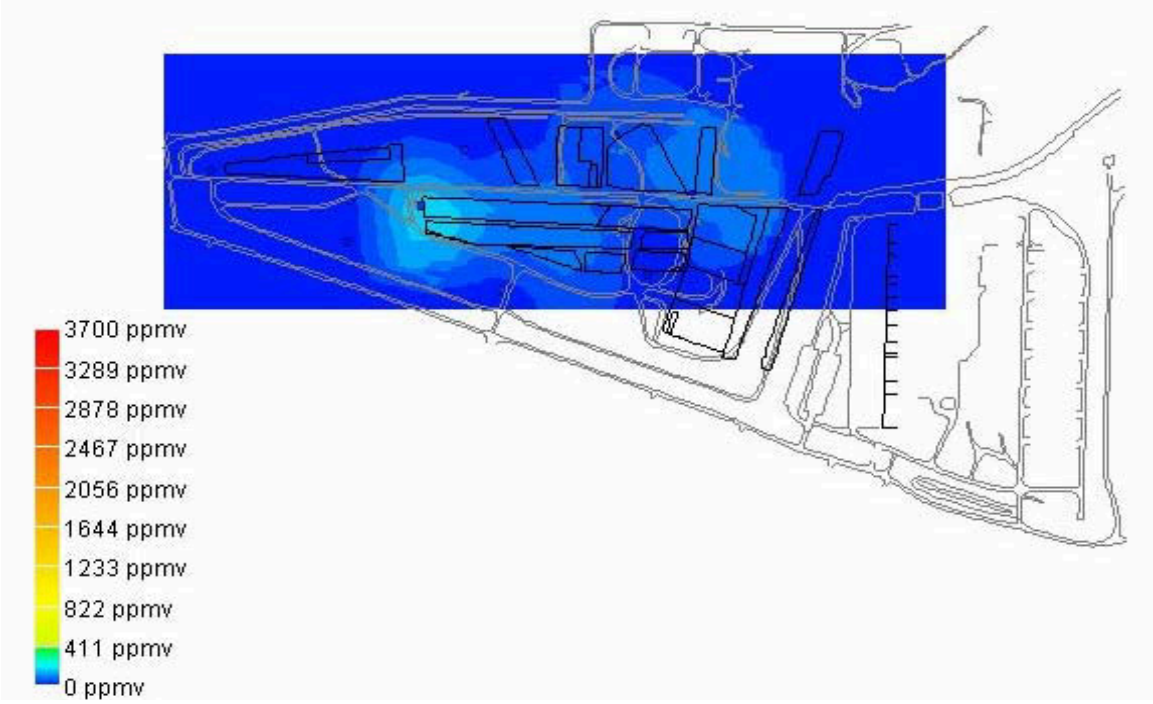

Figure 10-8. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in January 2002 (ICP 2004).

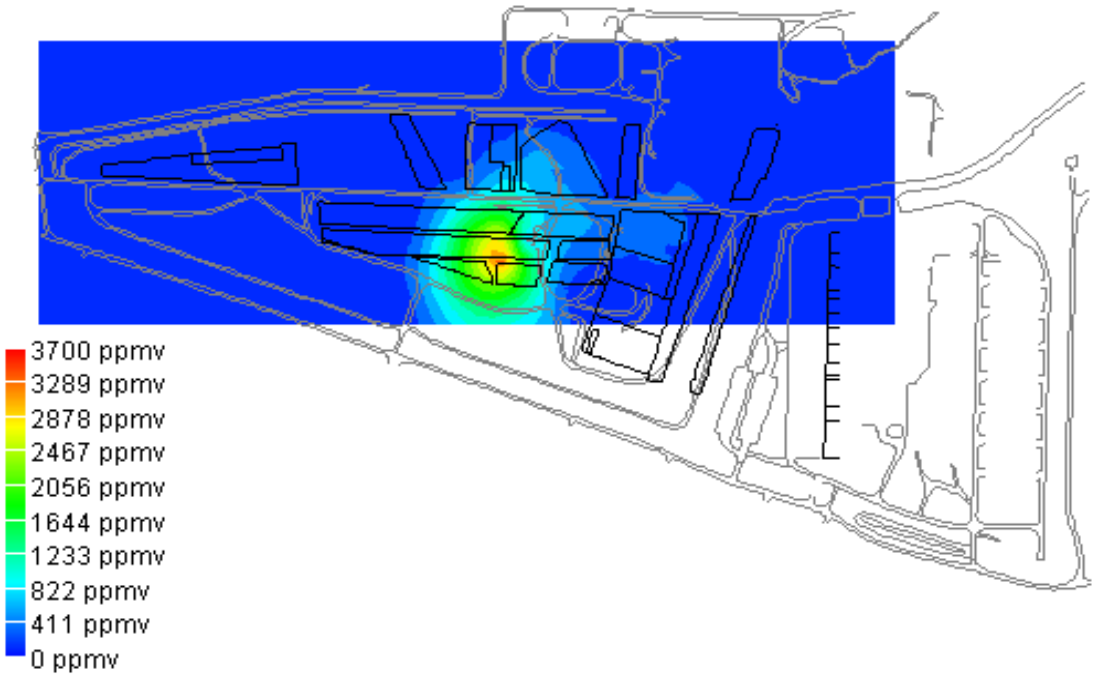

Figure 10-9. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in October 2003 (ICP 2004).

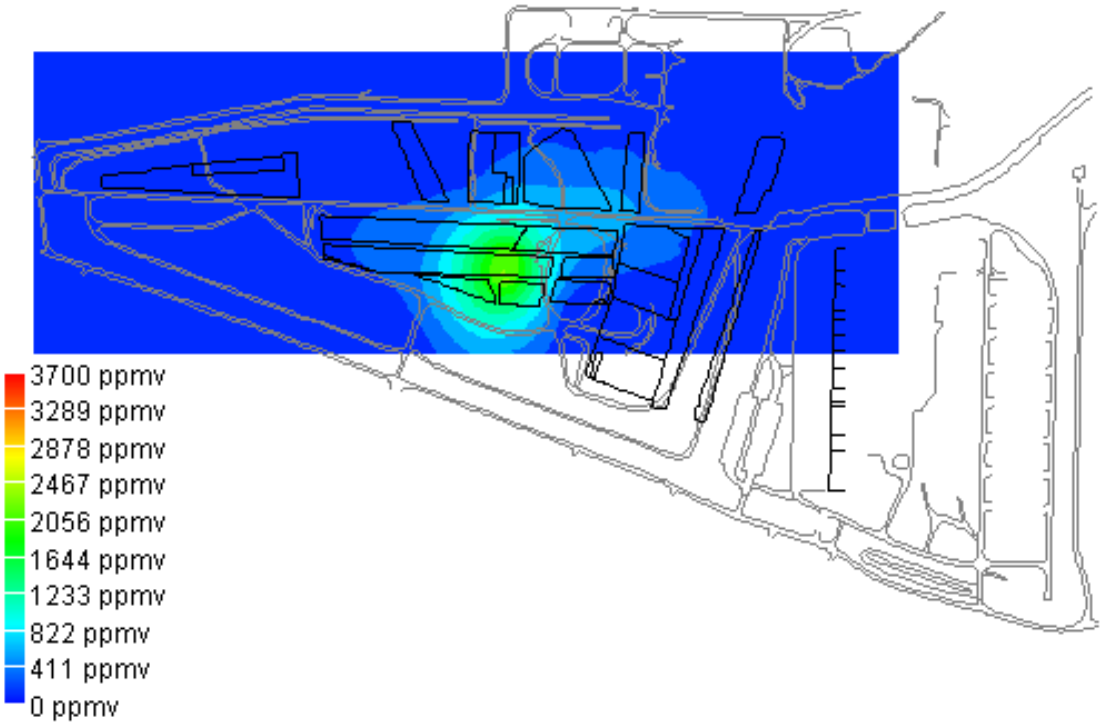

Figure 10-10. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in January 2004 (ICP 2004).

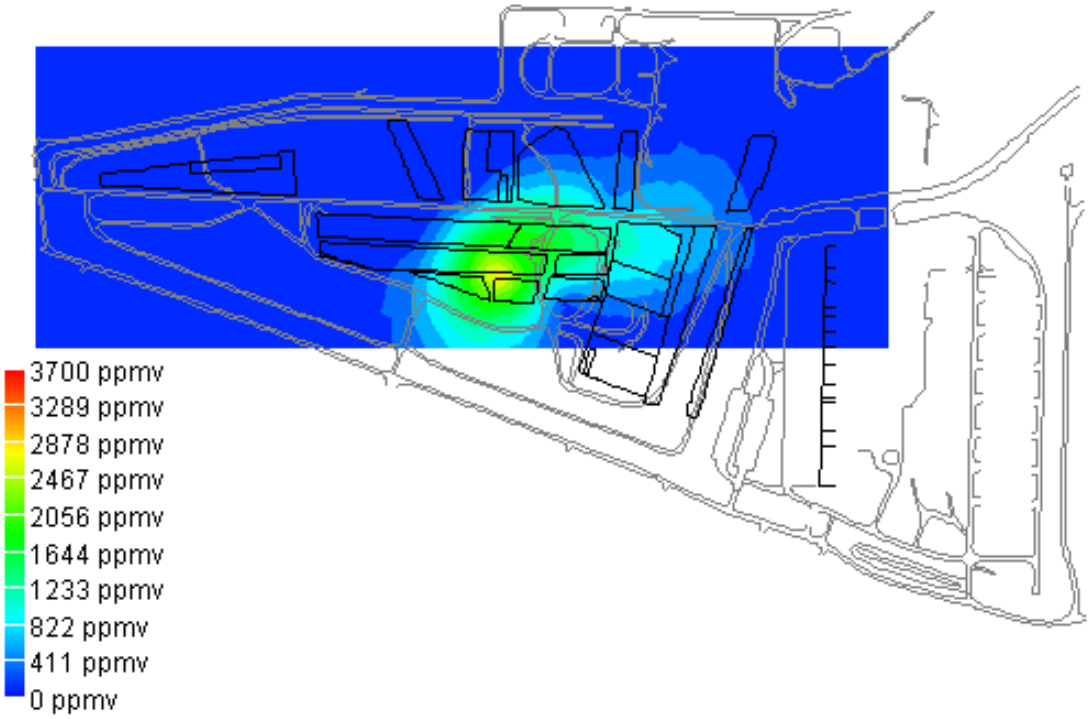

Figure 10-11. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in March 2004 (ICP 2004).

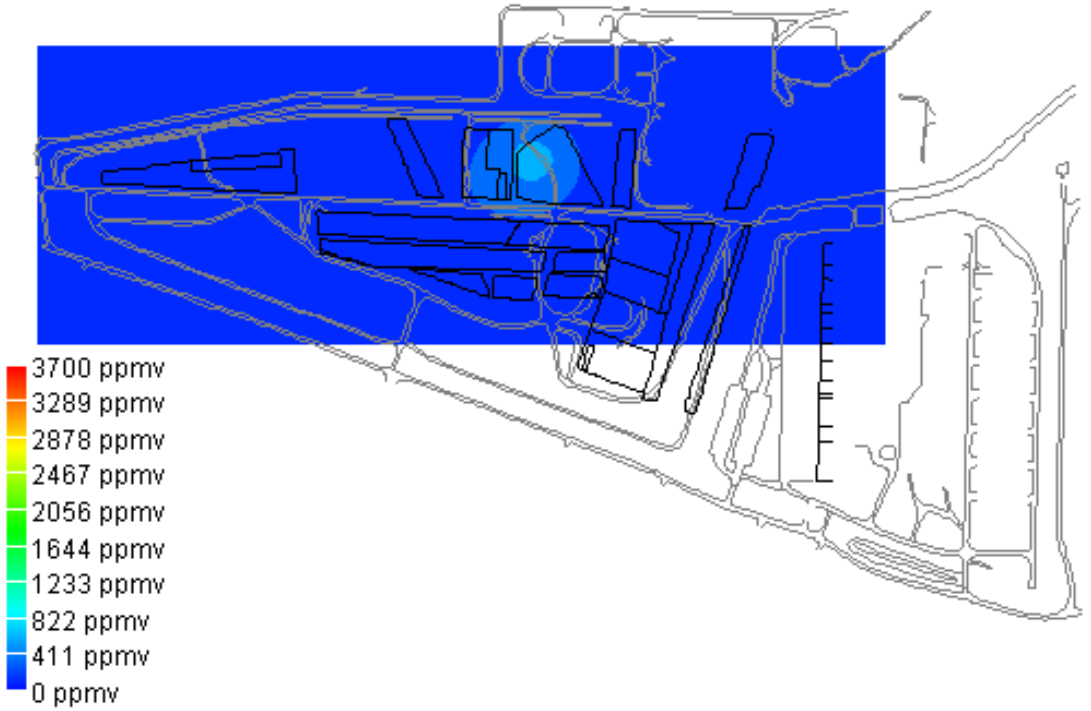

Figure 10-12. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in July 2004 (ICP 2004).

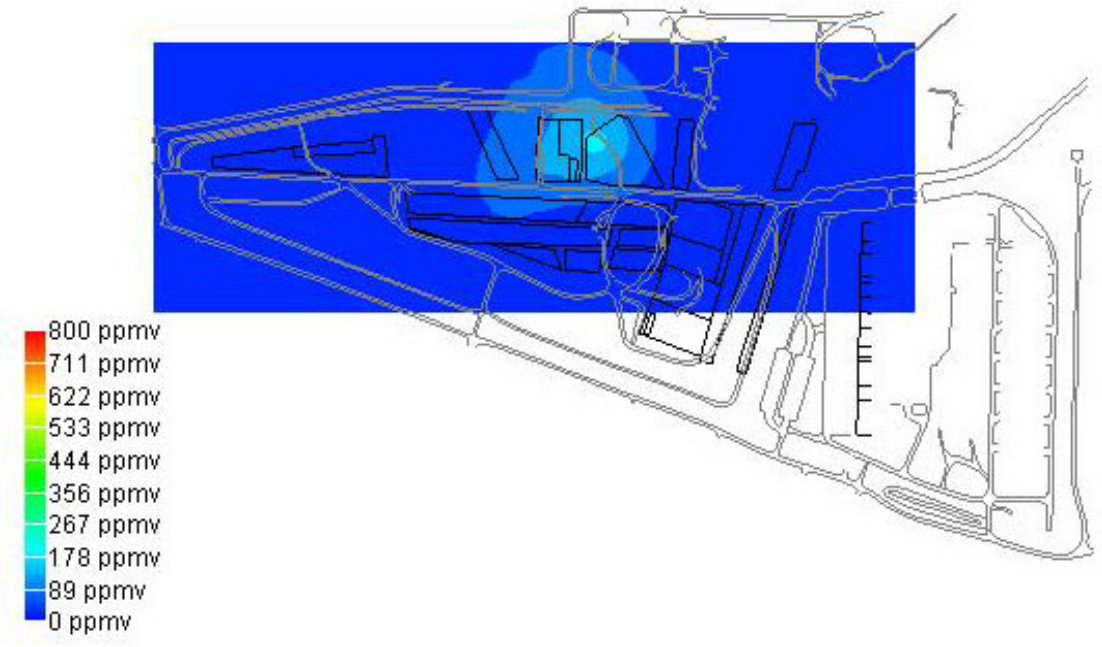

Figure 10-13. Spatial distribution of CCl_4 in the Subsurface Disposal Area at approximately 70 ft bls in September 2004 (ICP 2004).

10.1.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

Based on monitoring results, concentrations of contaminants are decreasing in the vast majority of the vadose zone monitoring points, especially above the B-C interbed (i.e., ~110 ft bls), where most of the extraction has occurred. Reductions in concentrations have been most steady in areas located away from source zones. Groundwater monitoring currently indicates two of 20 wells in the RWMC area (M7S and the RWMC production well) are above the MCLs for CCl_4. Some of the wells continue to show a slightly increasing trend in CCl_4 concentrations, while others indicate a flat or decreasing trend. The total extent of CCl_4 contamination in the SRPA downgradient of the RWMC is unknown. Although not remediated under the OU 7-08 ROD (DOE-ID 1994a), groundwater will be further investigated in the OU 7-13/14 comprehensive ROD and is important in evaluating the effectiveness of OCVZ extraction and treatment. The impacts of OCVZ operations were not expected to be manifest in the groundwater for several years, but continued extraction under the OCVZ Project is anticipated to result in declining groundwater concentrations.

Institutional controls, such as controlled access and fencing, are in place and remain effective, based on periodic inspections and monitoring of the site.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. There have been no changes in the RAOs found in the decision document and no new standards affecting the protectiveness of the remedy.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No.

10.1.5 Technical Assessment Summary

Issues that were discussed in the 2003 five-year review of OCVZ have been resolved favorably. The reliability of the OCVZ system has been greatly improved by replacing aging equipment. New extraction wells are in place to support the treatment units. Monitoring below the 240-ft interbed has been improved, as has the monitoring of exhaust gases. Based on monitoring results, concentrations of contaminants are decreasing in the vast majority of vadose zone monitoring points. Reductions in concentration have been most steady in areas located away from source zones. In addition, the source of the organic contaminants is being removed under separate remedial actions—i.e., plans call for most of the organics in Pit 4 to be removed. Removal of the source loading will have a positive impact on the conditions in the vadose zone below the SDA, as will the improved performance of the OCVZ treatment units.

Groundwater monitoring currently indicates that CCl_4 concentrations in two of the wells in the RWMC area are above the MCLs. Several of the wells show an increase in CCl_4 concentrations, but the rate of increase is slowing. Several other wells show a flat or decreasing trend in CCl_4 concentrations. Groundwater will be further investigated in the OU 7-14 comprehensive ROD and is not remediated under the OU 7-08 ROD (DOE-ID 1994a), but recognizing contaminant detections above MCLs is important. It is also important to note that impacts from OCVZ operations, especially the focus on shallow extraction, were not anticipated to influence groundwater for several years. However, continued OCVZ operations are expected to result in a reduction of groundwater concentrations to less than MCLs.

10.1.6 Issues

There are no outstanding issues related to the OCVZ remedial activity. The operation of the OCVZ units and associated monitoring will continue for the foreseeable future.

10.1.7 Recommendations and Follow-up Actions

Recommendations are to continue OCVZ system operation and perform associated monitoring.

10.1.8 Protectiveness Statement

The OCVZ remedy is functioning as the OU 7-08 ROD intended (DOE-ID 1994a). Current monitoring data indicate that the remedy is functioning as required to achieve current cleanup goals. The long-term effectiveness of the remedy will be verified by monitoring of VOCs in the vadose zone and in groundwater within and outside of the SDA boundary. Monitoring will continue for the foreseeable future.

10.2 Operable Unit 7-10 (Pit 9)

Covering an area of about 1 acre, Pit 9 is one of 10 pits (and 58 trenches) in the SDA where TRU waste, mixed waste, and other radioactive waste from the Rocky Flats Plant and other waste generators were disposed of between November 1967 and June 1969. During that period, drums and boxes of waste were dumped into the pit using trucks or bulldozers, and cranes were used to place large

items in the pit. The waste was then covered with soil after weekly or daily operations, depending on procedure requirements at the time of disposal.

In accordance with the Action Plan attached to the FFA/CO (DOE-ID 1991), OU 7-10 consists of the Pit 9 process demonstration interim action. In 1993, the *Record of Decision Declaration for Pit 9 at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory* was signed (DOE-ID 1993). The Pit 9 ROD specifies that OU 7-10 will be subject to a five-year review with the effectiveness of the Pit 9 interim action as a final action to be evaluated in OU 7-13 (i.e., the TRU-contaminated pits and trenches RI/FS).[a] The associated *Remedial Design/Remedial Action Scope of Work and Remedial Design Work Plan: Operable Unit 7-10 (Pit 9 Project Interim Action)* (EG&G 1993) documented the schedule and approach for implementation of the ROD; the DOE management and operating contractor subcontracted with Lockheed Martin Advanced Environmental Systems (LMAES) to perform the Pit 9 scope of work.

The Pit 9 scope of work was modified in Revision 1 of the associated *Remedial Design/Remedial Action Scope of Work and Remedial Design Work Plan: Operable Unit 7-10 (Pit 9 Project Interim Action)* (INEL 1995) to address details for design, construction, and operation approaches. This resulted in significant changes in cost estimates for the Pit 9 ROD (DOE-ID 1993), which in turn required issuance of the 1995 *Explanation of Significant Differences to the Pit 9 Interim Action Record of Decision at the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory* (DOE-ID 1995).

LMAES designed and then began construction of a retrieval facility and TRU waste processing building. However, in response to missed milestones by LMAES, the DOE-ID prepared a contingency plan to address the possibility that LMAES might not fulfill the terms of the Pit 9 scope of work (EG&G 1993). That contingency plan developed into the staged interim action approach formalized in Revision 2 of the *Remedial Design/Remedial Action Scope of Work and Remedial Design Work Plan: Operable Unit 7-10 (Pit 9 Project Interim Action)* (INEL 1997). It identified performance objectives, milestones, and deliverables in the event that the LMAES contract was not completed. The LMAES contract was subsequently terminated, and work began on the OU 7-10 Staged Interim Action Project. The uncompleted LMAES retrieval and processing structures remain at the Pit 9 site and are planned for future decommissioning.

The *Explanation of Significant Differences for the Pit 9 Interim Action Record of Decision at the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 1998) formalized adoption of a three-stage approach to satisfy requirements of the ROD and officially launched the OU 7-10 Staged Interim Action Project. The three stages of the OU 7-10 Staged Interim Action Project are as follows (INEL 1997, Appendix A):

- **Stage I**—Subsurface exploration of Pit 9 to support site selection for Stage II.
- **Stage II**—Retrieval of a selected area of Pit 9, including a waste retrieval demonstration, characterization of waste zone material and soil, and storage of retrieved waste zone material. Stage II also included design and construction, waste examination and packaging, and facility disposition.
- **Stage III—**Overall remediation of Pit 9 using information from Stage II.

a. The OU 7-13 TRU pits and trenches RI/FS was subsequently combined with the OU 7-14 WAG 7 comprehensive RI/FS into the OU 7-13/14 WAG 7 comprehensive RI/FS.

The purpose of the Stage I subsurface exploration was to obtain data from a portion of Pit 9 to support Stage II site selection for the limited excavation and retrieval of buried TRU waste. To meet the objectives of Stage I, a 40- × 40-ft study area was selected based on a review of inventory records of the pit and the results of noninvasive radiological and geophysical surveys of the pit. Subsurface exploration of this area included installation of tipped steel casings to allow probing by downhole data-logging instruments and subsequent coring to obtain samples for analysis and bench-scale treatability studies. The subsurface geophysical and radiation-detection logging in the cased probe holes was completed. Stage I objectives were effectively met with the selection of the location for the Stage II demonstration retrieval area.[b]

Requirements that applied to all three stages of the OU 7-10 Staged Interim Action Project were identified in the *OU 7-10 Staged Interim Action Project System Requirements Document* (LMITCO 1998), while the technical and functional requirements (TFRs) document—"Technical and Functional Requirements for the OU 7-10 Glovebox Excavator Method Project" (TFR-2527)—defined the Stage II scope and activities. TFR-2527 became the technical baseline used to develop the design for Stage II. The 90% design for Stage II was submitted to the agencies on June 15, 2000, as part of the *Remedial Design/Remedial Action Scope of Work and Remedial Design Work Plan: Operable Unit 7-10 (Pit 9 Project Interim Action)* (INEL 1997).

While the Stage II design met all technical requirements, the associated schedule did not meet the enforceable deadline for completion of the remedial action report. The DOE requested a schedule extension under the FFA/CO (DOE-ID 1991), but the request was denied by the agencies, resulting in a formal dispute in accordance with the provisions of the FFA/CO. As part of the dispute-resolution process, alternate concepts to demonstrate retrieval were developed. The alternate concepts focused on using simpler methods and shortening the overall duration of the retrieval demonstration. In some cases, the overall project objectives had to be modified from those of the original Stage II mission. The resulting concepts were documented in the *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications* (INEEL 2001). The concept selected was the glovebox excavator method (Figure 10-14). Through an agreement to resolve disputes (ARD) (DOE-ID 2002a), the agencies formally adopted the glovebox excavator method for accomplishing the Stage II mission and established new enforceable milestones for implementation of the Pit 9 Process Demonstration, including the future commencement of operations for Stage III. The *Remedial Design Package for the OU 7-10 Glovebox Excavator Method Project* (DOE-ID 2002b) was submitted to the agencies on October 1, 2002, and finally established the design requirements for implementing and completing Stage II through the glovebox excavator method. The agencies agreed to extend the remedial design and commence the Stage III construction milestone to March 31, 2008, in the *Agreement to Extend Deadlines* (DOE-ID 2004a).

Table 10-4 provides a chronology of significant events at OU 7-10.

10.2.1 Remedy Selection

Remedial action operations and maintenance activities for implementing Stage II of the OU 7-10 interim action included overburden removal, waste retrieval, underburden sampling, waste-drum storage, data collection and analysis, maintenance, and facility monitoring.

Overburden removal began on December 12, 2003. Waste zone retrieval operations began on January 5, 2004. On February 24, 2004, the DOE-ID notified the DEQ and the EPA of the completion of waste retrieval for the project.

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b. *OU 7-10 Stage I Subsurface Exploration and Treatability Studies Report (Draft) - Initial Probing Campaign (December 1999–June 2000)*, INEEL/EXT-2000-00403, Idaho National Engineering and Environmental Laboratory, July 2000

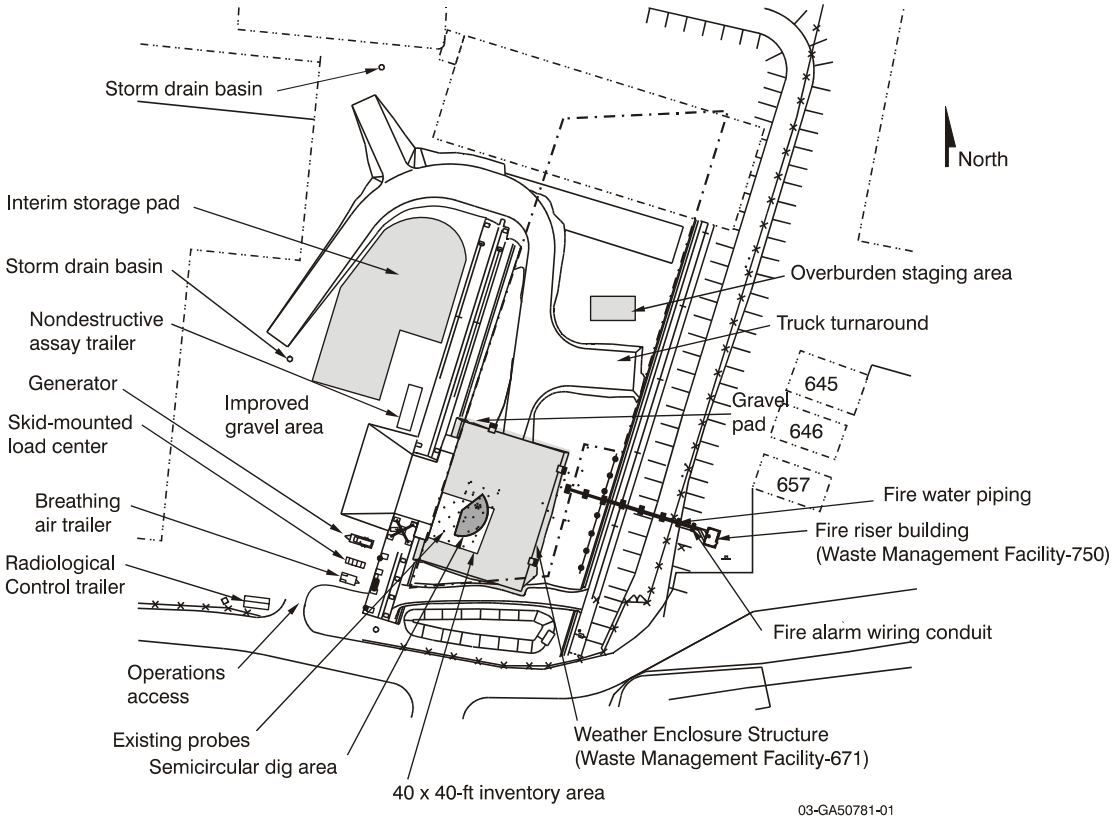

Figure 10-14. Site plan of the Operable Unit 7-10 Glovebox Excavator Method Project.

Table 10-4. Chronology of Operable Unit 7-10 events.

Event	Date
The RWMC was established.	1950
Rocky Flats Plant and INL Site waste materials were disposed of in Pit 9.	November 1967–June 1969
The Pit 9 Interim Action ROD (DOE-ID 1993) was signed by the agencies.	October 1993
The 1995 ESD (DOE-ID 1995) was issued.	January 1995
The Revised Pit 9 Scope of Work (INEL 1997) was issued. The revision included a contingency for a staged interim action approach if the LMAES contract was not completed.	October 1997
The LMAES subcontract for Pit 9 remediation was terminated.	June 1998
The 1998 ESD (DOE-ID 1998) was issued. The ESD adopted the three-stage approach to implement the Pit 9 interim action ROD.	September 1998
The *OU 7-10 Staged Interim Action Project System Requirement Document* (LMITCO 1998) was issued.	October 1998
The OU 7-10 interim action project, Stage II RD/RA work plan[a] was submitted to the agencies.	June 2000
The *OU 7-10 Stage I Subsurface Exploration and Treatability Studies Report (Draft)*[b] was completed.	July 2000

Table 10-4. (continued).

Event	Date
The *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications* (INEEL 2001) was completed. The analysis recommends adopting the glovebox excavator method as an improved approach for a Stage II retrieval demonstration.	October 2001
The ARD (DOE-ID 2002a) was signed by the agencies. The ARD formally adopts the glovebox excavator method as the approach to complete Stage II.	April 2002
The *Remedial Design Package for the OU 7-10 Glovebox Excavator Method Project* (DOE-ID 2002b) and the *Remedial Design Supplemental Package for the OU 7-10 Glovebox Excavator Method Project* (DOE-ID 2002c) were submitted.	October 2002
The construction and installation of process equipment were completed on the Glovebox Excavator Method Project facility.	May 2003
The agency prefinal inspection for the glovebox excavator method was completed.	November 2003
Retrieval of buried waste in Pit 9 was initiated.	January 2004
The Stage II/glovebox excavator method waste retrieval demonstration operations were completed. The design volume of 75 yd^3 of buried waste was retrieved.	February 2004
The agency final inspection for the glovebox excavator method was completed.	May 2004
The agreement to extend deadlines was signed by the EPA, DEQ, and DOE to memorialize that the Accelerated Retrieval Project met the Stage III 10% design milestone and to extend the completion date of the remedial design and commence the Stage III construction milestone until March 31, 2008 (DOE-ID 2004a).	June 2004
The *Remedial Action Report for the OU 7-10 Glovebox Excavator Method Project* (DOE-ID 2004b) was completed.	November 2004
The *Action Memorandum for Accelerated Retrieval of a Described Area within Pit 4* (DOE-ID 2004c) was signed. Implementation of the Accelerated Retrieval Project non-time critical removal action in Pit 4 will meet the 10% design milestone for Stage III activities in Pit 9.	August 2004
Construction of the Accelerated Retrieval Project facility at Pit 4 was completed.	September 2004

a. *Binder A-I Remedial Design/Remedial Action Work Plan for Stage II of the Operable Unit 7-10 (OU 7-10) Staged Interim Action Project*, DOE/ID-10767, Rev. Draft, U.S. Department of Energy Idaho Operations Office, June 2000
b. *OU 7-10 Stage I Subsurface Exploration and Treatability Studies Report (Draft) - Initial Probing Campaign (December 1999–June 2000)*, INEEL/EXT-2000-00403, Idaho National Engineering and Environmental Laboratory, July 2000.

ARD = agreement to resolve disputes
DEQ = [Idaho] Department of Environmental Quality
DOE = U.S. Department of Energy
DOE-ID = U.S. Department of Energy Idaho Operations Office
EPA = U.S. Environmental Protection Agency
ESD = Explanation of Significant Differences
INEEL = Idaho National Engineering and Environmental Laboratory
INEL = Idaho National Engineering Laboratory
INL = Idaho National Laboratory
LMAES = Lockheed Martin Advanced Environmental Systems
OU = operable unit
ROD = Record of Decision
RWMC = Radioactive Waste Management Complex

During the retrieval effort, excavator operators took scoops of waste zone materials (see Figure 10-15) and placed them in transfer carts at one of three gloveboxes. Glovebox operators moved the transfer carts into the gloveboxes, segregated the waste zone material (see Figure 10-16), separated and measured suspect fissile material, and packaged the waste in appropriate storage containers (i.e., 55-gal drums) in a safe and compliant manner. When operators suspected fissile material in the waste, the suspect material was placed in a separate bucket and moved to a fissile material monitor for measurement and subsequent placement in an appropriate drum, ensuring that criticality limits were never exceeded. Once the drums were filled, operators changed out drums and transferred them for assay measurement and then to interim storage in Building WMF-628, Type II Storage Module #1. Composite samples were analyzed to support application of hazardous waste numbers. Each drum identification number was entered into the Integrated Waste Tracking System (IWTS).

A total of 454 drums were filled during the retrieval effort, most containing approximately 5 ft^3 of waste materials, thus meeting a project objective of removing more than 75 yd^3 of material. Waste drums found in the pit had little structural integrity due to corrosion. However, plastic bags and plastic containers had retained much of their integrity. Some bags were more brittle than others, but most were in extremely good condition. It was noted that writing and markings on plastic containers and labels protected by plastic were often still clear and legible. Operators removed six underburden cores from the interface of the waste zone and underburden. Cores contained in Lexan tubes were removed from the core barrel, bagged out of the retrieval confinement structure, and shipped to a laboratory at INTEC for analysis.

The milestone for completion of the Pit 9 Stage III 10% design by September 2005 is being met through the ongoing removal action in Pit 4 of the SDA. In August 2004, the agencies signed an action memorandum to conduct a non-time-critical removal action for limited excavation and retrieval of selected waste streams from a 1/2-acre plot in the eastern portion of Pit 4. The waste in this area is primarily from the Rocky Flats Plant. The area was selected by the DOE, the DEQ, and the EPA based on inventory evaluations identifying significant quantities of TRU and other contaminated waste disposed of in the area. The project is referred to as the Accelerated Retrieval Project.

The focused objective of the non-time-critical removal action is to perform a targeted retrieval of certain Rocky Flats Plant waste streams that are highly contaminated with TRU radionuclides, VOCs, and various isotopes of uranium. Performance of the action will accomplish the following:

- Remove targeted waste streams and associated contaminants from a portion of the SDA
- Reduce the overall TRU, VOC, and uranium inventory buried within the SDA
- Establish the administrative process for certifying and transferring the resulting retrieved TRU waste streams to the Waste Isolation Pilot Plant in New Mexico
- Provide information to support remedial work at the RWMC as defined by future CERCLA removal action documentation or the OU 7-13/14 ROD.

The agencies also are proposing a second phase non-time-critical removal action in the remaining portions of Pit 4. The agreement to extend deadlines (DOE-ID 2004a) provides an enforceable milestone to complete the remedial design for Stage III and commence construction no later than March 31, 2008, and to begin operations within the following 36 months. The enforceable deadline for submittal of a draft OU 7-13/14 ROD is December 31, 2007.

Figure 10-15. The glovebox excavator retrieving waste from Pit 9.

Figure 10-16. Glovebox excavator operators segregating waste retrieved from Pit 9.

10.2.2 Data Evaluation

Data collected during the Glovebox Excavator Method Project are presented in the *Remedial Action Report for the OU 7-10 Glovebox Excavator Method Project* (DOE-ID 2004b). A brief summary of environmental and waste management-related data is included in the following subsections. The data primarily include analyses of stack air emissions, radiological assay and solids sampling of retrieved waste, and sampling of underburden soils. This information will support the design efforts for future waste retrieval operations in the SDA and has been factored into the design planning for the Accelerated Retrieval Project. The data obtained from completion of Stage II provide information relevant to predicting impacts from future retrieval operations as they pertain to occupational exposures, waste classifications for disposition, and air emissions estimates.

Biased and composite sampling of waste zone material (i.e., soil and waste solids) was performed in the designated excavation area of Pit 9. The composite waste zone sampling process required the collection of small incremental subsamples from each cart used to fill each drum in a five-drum campaign. Subsamples from all carts used to fill five drums were composited into one sample representing the five-drum campaign. The sampling strategy was designed to provide a very accurate estimate of the population mean, because every drum contributes to the estimate by contributing to a five-drum composite.

Sample analysis results provided the basis for determining the upper 90% confidence limit (UCL_{90}) of the mean concentration of the contaminants listed in the DQOs. As stated in Section 2.1.4 of the *Field Sampling Plan for the OU 7-10 Glovebox Excavator Method Project* (Salomon et al. 2003), the boundary of this characterization was the physical contents of the newly packaged drum population being characterized. Material type was limited to nondebris waste because, for the analyses required by the FSP, debris waste would be better characterized using acceptable knowledge and nondestructive analysis. The results from laboratory analyses of the composited waste samples are appropriately applied to only the population of nondebris, soil, and waste-solids drums.

A statistical analysis of the composite sample data was performed. The purpose of the statistical analysis of the data collected is to calculate the UCL_{90} for the population means and compare that to regulatory thresholds to determine whether hazardous waste codes should be assigned.

The interpretation of the UCL_{90} is that the project can be 90% confident that the true population mean is less than the UCL_{90} value computed from the sample mean and standard deviation. If the UCL_{90} value is less than the regulatory threshold, then the project has demonstrated with at least 90% confidence that the true population mean is less than the regulatory threshold.

The project collected 82 composite samples from the waste zone. The mean concentration, standard deviation, and UCL_{90} for each contaminant are presented in the following subsections by analysis type.

10.2.2.1 Polychlorinated Biphenyls. The total PCB result of 37 mg/kg is a sum of the UCL_{90} results for the PCB congeners. The result is below the TSCA (15 USC § 2601 et seq.) regulatory limit of 50 mg/kg. Total PCBs are identified as an underlying hazardous constituent (UHC) for the soil and waste-solids drum population, because the total is greater than 10 mg/kg.

10.2.2.2 Semivolatile Organic Compounds. No hazardous waste codes or UHC codes are applied to the soil and waste-solids drum population based on results of the semivolatile organic compound analysis.

10.2.2.3 Volatile Organic Compounds. Hazardous Waste Codes D028, D018, D019, D039, D040, and D043 are applied to the soil and waste-solids drum population based on the 1,2-dichloroethane, benzene, CCl_4, PCE, TCE, and vinyl chloride analysis results, respectively. The 1,1,1-TCA, 1,1,2,2-PCE, 1,1,2-TCA, 1,1-dichloroethene, carbon disulfide, chlorobenzene, ethylbenzene, methanol, and toluene are identified as UHCs for the soil and waste-solids drum population.

10.2.2.4 Metals. Cadmium, chromium, lead, vanadium, and zinc are identified as UHCs for the soil and waste-solids drum population.

10.2.2.5 Nitrate. Analysis for nitrate was performed for each soil and waste-solids composite sample. No hazardous waste codes or UHCs were identified for the soil and waste-solids drum population.

10.2.2.6 Biased Samples. The project included biased sampling to identify potential drum subpopulations that could pose a safety risk or regulatory issue to the project. Included in this category were drums suspected of containing nitrate-bearing waste (because of their ignitable potential that affects both safety and regulatory issues), uncontainerized liquids potentially containing liquid PCBs, cyanide pellets or other special-case waste, outlier waste, and other unplanned sampling opportunities. During waste examination and packaging operations, four samples were collected from material that might contain nitrate-bearing waste. No uncontainerized liquids, cyanide pellets, or other special-case waste were identified for sampling during excavation. No hazardous waste codes were applied to the at-risk drums based on the biased samples collected.

The biased nitrate sample represents (proportionally) both suspect and nonsuspect material. Nonsuspect material (e.g., soil and other waste) would contribute to the sample in the approximate proportion that they exist compared to the suspect nitrate-bearing material in the cart. Therefore, while the results of the biased sampling are useful to support identification of at-risk (i.e., nitrate) drums, the reported concentrations are only representative of the cart and do not represent the contaminant concentrations of the nitrate-bearing waste or the final concentration of a particular drum.

Biased samples of sludge and biased samples of interstitial soil were collected to support ongoing OU 7-13/14 studies. Results will be presented in final reports for the retrieved waste and soils characterization and the preremedial design testing studies.

10.2.2.7 Volatile Organic Compound Monitoring. Photoionization detector readings were taken from the exhaust duct after the high-efficiency particulate air (HEPA) filters. Readings were taken on an intermittent basis from May 28, 2003, to February 25, 2004 (DOE-ID 2004b).

The SUMMA sampling was performed at various times from the exhaust duct after the HEPA filters (McIlwain 2004). These samples were sent to an off-Site laboratory for analysis. Results of these readings are presented in Figure 10-17 with a comparison to anticipated VOC levels, as documented in EDF-2376, “Estimates of Carbon Tetrachloride Air Concentrations within the OU 7-10 Retrieval Confinement Structure and Packaging Glovebox System during Various Phases of Stage II Retrieval Activities,” and with photo ionization detector readings. The results of the SUMMA grab sample analysis include total measured VOCs and measured CCl_4. Measured VOCs were approximately half the anticipated levels over the measurement period.

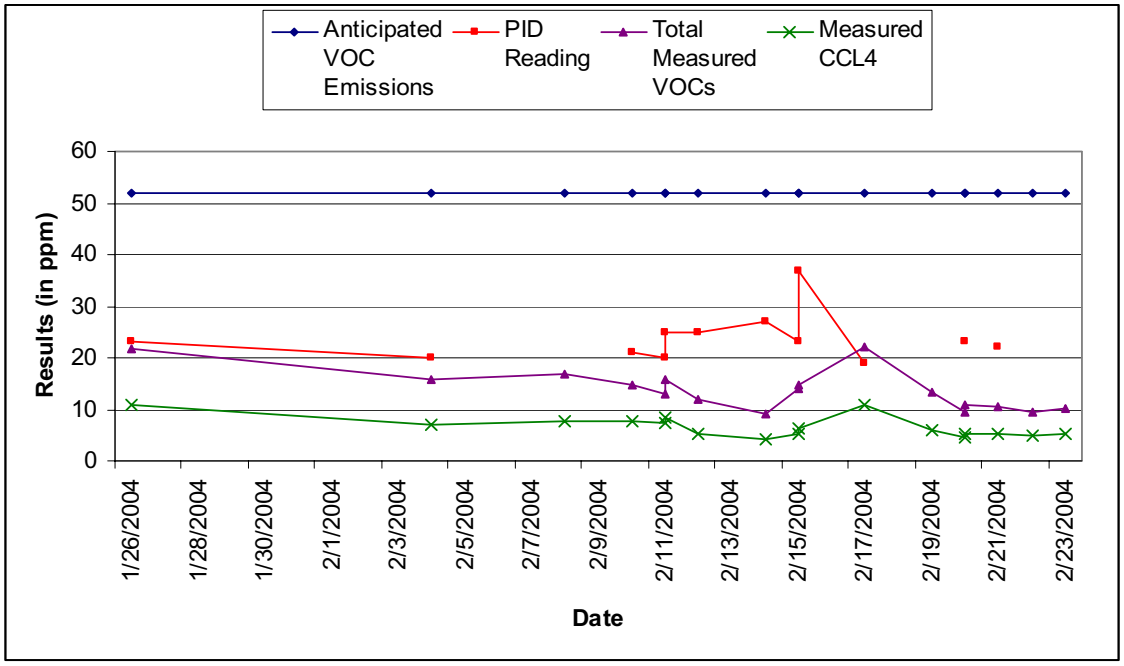

Figure 10-17. Comparison of anticipated volatile organic compound levels with photoionization detector readings and SUMMA canister grab sample analytical results.

10.2.2.8 Radiological Assay. Four hundred fifty-four drums were assayed. Most of them had only a small amount of TRU activity present, primarily from Am-241. Each of the isotopes Pu-238, Pu-239, Pu-240, Pu-241, U-235, U-238, Am-241, Np-237, Na-22, and Cs-137 was detected at least once. The dominant isotopes were Am-241 and Pu-239. The Pu-239 fissile gram equivalent values calculated for the assayed drums were all below 100 g, except for one drum, GEM030438, which calculated to 363 g with the inclusion of the 1-sigma error. Isotopic measurements showed isotopic distribution consistent with weapons-grade plutonium distributions. Sixty drums were found to be TRU waste, based on the assay value for total concentrations. If the 1-sigma error was included, the number of TRU waste drums increases to 193.

10.2.2.9 Underburden Sampling. The core sampling performed was intended to characterize contaminants of interest in the underburden and to support subsequent evaluations of the potential for contaminant migration. Five locations were sampled, and a duplicate core was obtained for one of the locations. Results of the analyses are presented in the Remedial Action Report (DOE-ID 2004b).

Results in the Remedial Action Report (DOE-ID 2004b) confirm that the presumed underburden contains high levels of TRU contaminants with two subsamples exhibiting Pu-239 concentrations greater than 100 nCi/g. Preliminary evaluation of the relative abundance of TRU elements within these subsamples suggests that this contamination most likely resulted from mixing of waste and underburden soil during waste retrieval. Variations in the relative abundance of Pu-239 and Am-241 from subsamples are suggestive of chemical transport processes.

10.2.3 Progress since Last Review

This is the first review of the remedy for OU 7-10. Periodic modifications to the remedy originally described in the 1993 OU 7-10 ROD (DOE-ID 1993) have occurred more often than 5-year intervals, precluding the need to perform a review before now.

10.2.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

The waste retrieval and processing demonstration from the Glovebox Excavator Method Project, as well as activities now under way for the Accelerated Retrieval Project, have shown that TRU waste removal at the SDA is technically viable. Stage III operations for Pit 9 are still in the design phase.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?*

The OU 7-10 response action was undertaken as an interim action and a demonstration project. It is anticipated that the final cleanup levels and RAOs will be established either through the Stage III remedial design approval process or through issuance of a future ROD or ROD modification. The final exposure assumptions, toxicity data, cleanup levels, and RAOs for the SDA will be established through the issuance of the OU 7-13/14 ROD.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No.

10.2.5 Technical Assessment Summary

The remedy for OU 7-10 is a buried waste retrieval demonstration that is composed of three principal components. Stage I provided for further investigation of Pit 9 to identify a suitable location to conduct Stage II operations. Stage II provided for limited retrieval of a portion of Pit 9 and collection of data to support future waste retrieval operations at the SDA. Stage III will provide for waste retrieval operations over the remainder of Pit 9. Stage I and II operations have been completed and have successfully demonstrated that retrieval of buried waste at the SDA is technically viable. Remedial design activities for Stage III are under way and are being supported by the Accelerated Retrieval Project removal action in Pit 4.

10.2.6 Issues

Two open questions have been identified during this five-year review of the remedy for OU 7-10. First, the amount of retrieved waste that will require treatment to meet the waste acceptance criteria for the Waste Isolation Pilot Plant is unknown. This uncertainty complicates the ability to develop reliable cost estimates for Stage III operations and to determine compliance approaches for ARARs. Second, the RAOs, the ARARs, and the treatment train identified in the OU 7-10 ROD need to be updated. The original ROD was signed 11 years ago, and several developments since then create a need to update the requirements. These developments include the 1995 and 1998 ESDs (DOE-ID 1995; DOE-ID 1998), the 2002 ARD (DOE-ID 2002a), and the 2004 *Agreement to Extend Deadlines* (DOE-ID 2004a).

10.2.7 Recommendations and Follow-up Activities

The Accelerated Retrieval Project removal action is fulfilling the requirements in the ARD (DOE-ID 2002a) for a 10% Stage III remedial design by September 2005. Estimates of the amount of retrieved waste that will need to be treated will be obtained from experience gained through the removal actions. Assumptions about waste treatment volumes from the Accelerated Retrieval Project can be included in the 90% Stage III remedial design.

Significant changes in OU 7-10 ROD implementation have occurred since the LMAES subcontract was terminated; therefore, the RAOs, ARARs, treatment train, and enforceable schedules identified in the ROD have been modified through several subsequent documents. These requirements should be updated and consolidated in a single reference through either the Stage III remedial design process or a future ROD modification.

10.2.8 Protectiveness Statement

Upon completion, the OU 7-10 remedy is expected to be protective of human health and the environment. In the interim, exposure pathways that could result in unacceptable risk are being controlled. The OU 7-10 remedy is being implemented as a demonstration project and is not intended to be the final remedy for the SDA.

The milestone for completion of the Pit 9 Stage III 10% design is being met through the ongoing removal action in Pit 4 (i.e., the Accelerated Retrieval Project). The ARD (DOE-ID 2002a) establishes the milestone for commencement of operations for Stage III of the OU 7-10 demonstration project no later than March 31, 2010. The 2004 agreement to extend deadlines extends the deadline for remedial design and commencing construction until March 31, 2008 (DOE-ID 2004b). The final remedy for the SDA will be determined by the OU 7-13/14 ROD. The draft OU 7-13/14 ROD is scheduled for submittal to the DEQ and EPA no later than December 31, 2007.

10.3 Operable Unit 7-12 (Pad A)

Pad A is an aboveground, earthen-covered disposal site at the SDA where approximately 13,300 yd^3 of containerized waste was placed from September 1972 to August 1978. The waste is composed primarily of nitrate salts, depleted uranium waste, and sewer sludge. Typically, the waste exhibited dose rates of less than 200 mR/hr at the surface of each container.

In 1978, Pad A was closed by placing plywood and/or polyethylene over the exposed containers. The waste pile was then covered by a layer of soil with an average thickness of 4 ft, and crested wheat grass was planted in the soil layer. Remediation of Pad A is addressed under OU 7-12 and was accomplished in accordance with the *Record of Decision Declaration for Pad A at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory* (DOE-ID 1994b).

A risk assessment of Pad A indicated that it posed no current risk to workers or the public. Fate and transport modeling indicated that drinking water standards for nitrates might be exceeded in about 250 years if residents use the groundwater directly adjacent to the Pad A boundary, but the modeling used conservative assumptions to avoid underestimating the risks. Actual nitrate concentrations in groundwater were not expected to exceed drinking water standards at the WAG 7 boundary, thus Pad A was not expected to pose an unacceptable risk to human health or the environment (DOE-ID 1994b).

In 1997, the EPA completed the *Two-Year Review Idaho National Engineering Laboratory Subsurface Disposal Area Pad A Operable Unit 7-12* (EPA 1997), which was reviewed by the DEQ. The DEQ certified that the limited action remedy for Pad A was protective of human health and the environment. However, subsidence of the soil cover, the frequency of inspections, and the inability to establish adequate grass cover were issues.

A two-phase limited action was completed in 1995 to prevent contact with waste disposed of at Pad A. Phase I consisted of recontouring the sides of the pad to establish appropriate slopes and grading the top of the pad to achieve a minimum 5% slope. Phase II consisted of installation of suction lysimeters

and neutron access tubes to provide early detection of potential contaminant releases to the environment. Results of this limited action are presented in the *Remedial Action Report Pad A Limited Action Operable Unit 7-12* (Parsons Engineering Science 1995a).

In 2003, the *Five-Year Review Report for OU 7-12 (Pad A) Idaho National Engineering and Environmental Laboratory* (EPA 2003) was completed by the EPA and reviewed by the DEQ. The EPA determined that the remedy prescribed for Pad A was protective of human health and the environment. The data indicated that the cover was protective, ongoing maintenance and institutional controls precluded prolonged direct contact with Pad A contaminants, and the remedy was functioning as required. However, continued monitoring was recommended. The continued lack of vegetation in some areas was also a concern.

The SDA, including Pad A, is being evaluated in the WAG 7 comprehensive RI/FS. Future decisions about OU 7-13/14 could affect elements of Pad A long-term stewardship. Table 10-5 provides a chronology of significant events at OU 7-12.

Table 10-5. Chronology of significant Operable Unit 7-12 events.

Event	Date
Pad A was constructed and used to dispose of waste.	1972–1978
Environmental monitoring and investigations were conducted.	1978–1989
The INL Site received its final listing on the National Priorities List (54 FR 29820).	November 21, 1991
The FFA/CO (DOE-ID 1991) for the INL Site was signed.	December 9, 1991
Public scoping meetings for Pad A were held.	December 1991
The Pad A RI/FS was made available to the public.	January 1992
The Pad A proposed plan identifying the preferred remedy was presented to the public, and the public comment period began (INEL 1993).	July 1993
The ROD selecting the limited action remedy was signed (DOE-ID 1994b).	January 27, 1994
The short-term monitoring plan was approved (Parsons Science Engineering 1995a, Appendix A).	June 1994
The Pad A limited action was completed.	May 1995
The *Remedial Action Report Pad A Limited Action Operable Unit 7-12* was completed (Parsons Engineering Science 1995a).	July 1995
The *Pad A Limited Action Long-Term Monitoring Plan, Operable Unit 7-12* was approved (Parsons Engineering Science 1995b).	August 1995
The two-year review was completed.	December 17, 1997
The operations, maintenance, and monitoring plan was revised (Parsons Engineering Science 1995a, Appendix N).	January 2001
The five-year review was completed.	September 2003
Post-ROD monitoring is conducted.	1994–2005
The *Operations and Maintenance Plan for the Pad A Limited Action Operable Unit 7-12 at the Radioactive Waste Management Complex* was revised (Flynn 2005).	June 2005

DOE-ID = U.S. Department of Energy Idaho Operations Office
FFA/CO = Federal Facility Agreement and Consent Order
FR = *Federal Register*
INEL = Idaho National Engineering Laboratory
INL = Idaho National Laboratory
RI/FS = remedial investigation/feasibility study
ROD = Record of Decision

10.3.1 Remedial Actions

10.3.1.1 Remedy Selection. In 1994, a ROD was signed for OU 7-12 (DOE-ID 1994b). Later in 1994, the *Remedial Design/Remedial Action (RD/RA) Work Plan, Pad A Limited Action Radioactive Waste Management Complex, Operable Unit (OU) 7-12* was signed (INEL 1994). The limited action described in the ROD prescribed that the waste be left in place and included recontouring and slope correction, cover maintenance and monitoring, and institutional controls. Pad A was intended to be a permanent solution where the waste could be reliably controlled in place. Treatment of the principal sources of contamination was not found to be necessary.

Because the remedy resulted in waste remaining onsite, continued maintenance and monitoring of Pad A were required. Maintenance was to include subsidence and erosion control of the Pad A cover. Monitoring also was prescribed to ensure the effectiveness of the existing cover. Groundwater, air, surface water, and soil monitoring were designed to provide early detection of a potential release to the subsurface, groundwater, or surface pathways and ensure that the cover remains effective.

Institutional controls were also to continue in order to protect human health and the environment.

10.3.1.2 Remedial Action Objectives. The focus of the RAOs was to maintain the effectiveness of the soil and grass cover on Pad A in order to prevent direct exposure to the waste and to minimize the potential for contamination to migrate from the waste. Since the last review, however, it was noted that revegetation efforts have not improved the vegetative cover in certain portions of Pad A, but no significant erosion has occurred in these areas. Therefore, the revegetation efforts have been suspended, as agreed upon by the agencies.

The RAOs also included the identification of PRGs that are established based on risk and frequently used standards or ARARs. The selected remedy for Pad A satisfies the criterion of overall protection of human health and the environment by minimizing the risk of potential contaminant migration to groundwater and by preventing direct contact with the Pad A waste materials. No chemical-specific ARARs are identified for the Pad A selected remedy.

10.3.1.3 Remedy Implementation. The Pad A remedy was implemented in two phases. The first phase consisted of recontouring the Pad A slopes, which was done between August and November 1995.

The second phase consisted of installing environmental monitoring equipment. This involved drilling boreholes, which were completed between April and July 1995. The RD/RA Work Plan (INEL 1994) specified that the EPA and DEQ would perform independent reviews of the maintenance and monitoring data within 2 years to ensure that the remedy continued to provide adequate protection of human health and the environment. The prefinal inspection for the first-phase recontouring activities was done on December 9, 1994. Outstanding items from the prefinal inspection were resolved and documented in the RD/RA Work Plan (INEL 1994). The EPA and DEQ determined that all remedial action construction activities, including implementation and monitoring of institutional controls, were performed according to specifications.

The ongoing phase of remedy implementation at Pad A consists of long-term monitoring and maintenance. The *Operations and Maintenance Plan for the Pad Limited Action Operable Unit 7-12 at the Radioactive Waste Management Complex* (Flynn 2005) has been revised. The primary activities associated with operations and maintenance include the following:

- Inspection and corrective maintenance of the soil cover
- Inspection and corrective maintenance of the rock armoring

- Monitoring of aquifer wells
- Monitoring of the vegetative cover, soil cover, and rock armor
- Inspection of institutional controls.

10.3.2 Data Evaluation

Seventy lysimeters and perched water wells at WAG 7 are sampled annually and analyzed for radionuclides, nitrate, metals, and VOCs (sample volume permitting). The locations of the lysimeters, perched water wells, and the contaminants detected there are shown in Figure 10-18.

At Pad A, the PA01, PA02, PA03, D06, and TW-1 lysimeter vadose zone wells have been sampled annually.[c] In addition, the USGS-092 perched water well is monitored for nitrate concentrations, which continue to increase. Figure 10-19 shows the trend for nitrates in Pad A lysimeters (including I4S:DL11) and in USGS-092. Elevated nitrate concentrations are observed in the vicinity of Pad A to depths around 100 ft bls (TW1 and I-4S). The drinking water MCL for nitrate is shown in Figure 10-18 for comparison only.

In addition, monthly operations and maintenance reports since the last review in 2003 indicate occasional small animal intrusions, minor weed growth, and minor subsidence events. One substantial subsidence event was noted on April 5, 2004, on the northeast side of Pad A. The subsidence was approximately three-quarters of the way to the top of the pad and was approximately 3 ft long, 1 ft wide, and 1 ft deep. The subsidence was repaired in accordance with the requirement in the ROD. Pad A still has no growth on the top and the north-northeast side.

Institutional controls at Pad A are monitored as part of the monthly operations and maintenance inspections and annually as part of the Sitewide institutional controls inspection. Institutional controls at Pad A are in place and functioning as intended. In addition, institutional controls are in place and functioning at the SDA, which surrounds the Pad A site.

Since the five-year review in 2003, the annual Pad A inspection report consisted of compiling all of the monthly inspections and submitting them along with a topographical map generated from the FY 2004 survey for agency review. No significant issues have been identified regarding the cap.

10.3.3 Progress since Last Review

In 2003, the *Five-Year Review Report for OU 7-12 (Pad A) Idaho National Engineering and Environmental Laboratory* (EPA 2003) was completed by the EPA and reviewed by the DEQ. The EPA determined that the remedy at Pad A was protective of human health and the environment. The data indicated that the cover was protective, ongoing maintenance and institutional controls preclude prolonged direct contact with the water, and the remedy is functioning as required to achieve cleanup goals. However, continued monitoring actions were recommended to ensure that concentrations of contaminants in groundwater continue to decrease as anticipated. The continued lack of vegetation in some areas also was an issue of concern as was the status of the Operations and Maintenance Plan and the Institutional Controls Plan.

c. The requirement to monitor preferentially for nitrates annually from the Pad A lysimeters has been eliminated from the revised Pad A Operations and Maintenance Plan based on cumulative risk assessments for OU 7-13/14 (Flynn 2005).

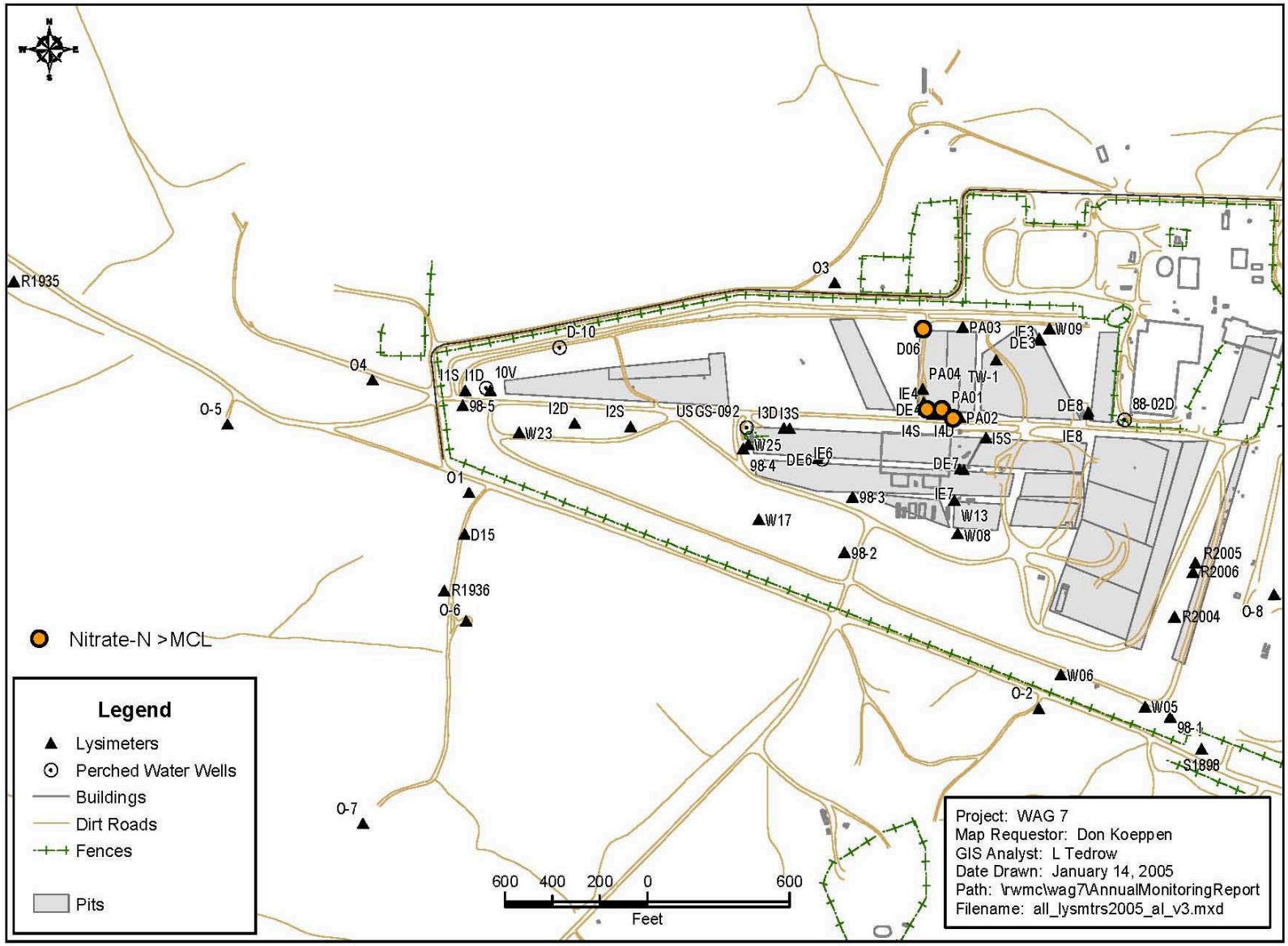

Figure 10-18. Lysimeters and monitoring wells at Waste Area Group 7.

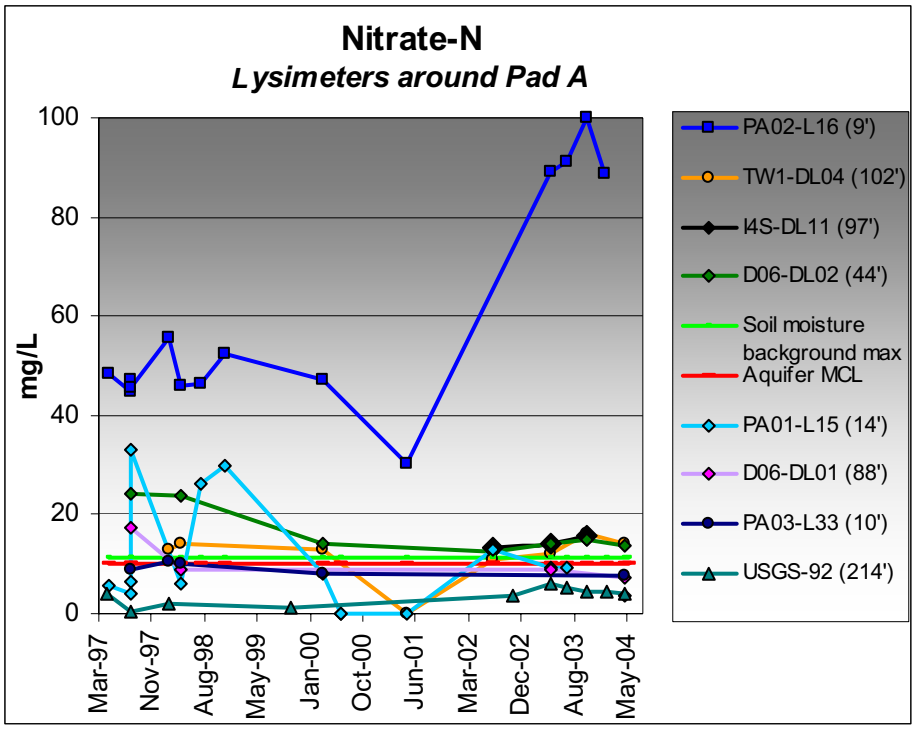

Figure 10-19. Nitrogen concentrations in lysimeters located around Pad A and in the USGS-092 well.

Required operations and maintenance, inspection sampling, and monitoring have been performed, documented, and reported. Occasional subsidence has been reported and corrected. Since the last review, it was noted that revegetation efforts have not improved vegetative cover in certain portions of Pad A. However, no significant erosion has occurred in those areas. Therefore, the revegetation efforts have been suspended, as agreed upon by the agencies. The Pad A Operations and Maintenance Plan (Flynn 2005) was revised to remove the requirement for annual revegetation.

The requirement for annual preferential monitoring of nitrates at the Pad A lysimeters has also been eliminated from the revised Operations and Maintenance Plan (Flynn 2005), based on cumulative risk assessments for OU 7-13/14. The cumulative nitrate hazard index for the entire SDA using the upper-bound inventory for nitrates is 1 (Holden et al. 2002). The nitrate hazard index is based on best-estimate inventory and is less than the threshold value for remedial decision-making. Because Pad A nitrate sampling is conducted in conjunction with other WAG 7 sampling and the nitrate hazard index is 1, nitrates will be analyzed in lysimeter samples only when sufficient sample volume is available after other analytical priorities have been fulfilled. This change has been documented in the revised Operations and Maintenance Plan (Flynn 2005).

10.3.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

The remedy is functioning as intended by the OU 7-12 ROD. The subsidence events have been minimal since the last review and have been repaired. Revegetation efforts have been discontinued on the portions of Pad A that have consistently failed to produce vegetative cover. Operations and maintenance costs are consistent with previous costs.

The lysimeter and monitoring well network is sufficient to provide data to assess potential releases from the pad. Maintenance on the cap is sufficient to maintain the integrity of the cap.

The required institutional controls are in place and functioning as intended. No activities were observed that would have violated institutional controls. The fence around the site is intact and in good repair.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?*

Yes.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

Lysimeter and well samples show nitrate concentrations at low levels with increasing trends. In addition, these constituents have been detected at lower depths since the last review. These trends, while they do raise questions as to the protectiveness of the Pad A remedy, are best viewed in the context of the SDA as a whole. Pad A is being evaluated in the OU 7-13/14 comprehensive RI/FS for WAG 7.

10.3.5 Technical Assessment Summary

Results from the monitoring at WAG 7 indicate that some contaminants are migrating from the waste zone. Nitrates are routinely detected around Pad A and should continue to be evaluated cumulatively under OU 7-13/14. Concentration trends associated with nitrates around Pad A are significant (Koeppen et al. 2005).

The SDA, including Pad A, is being evaluated in the WAG 7 comprehensive RI/FS. Future decisions for OU 7-13/14 could affect elements of Pad A long-term stewardship.

10.3.6 Issues

Issues at Pad A include the continued detection of nitrates in the vadose zone. The significance of the detections is being evaluated in the context of the entire SDA in the OU 7-13/14 RI/FS.

10.3.7 Recommendations and Follow-up Actions

Operations, maintenance, and inspections should be continued at Pad A. Vadose zone monitoring should continue under OU 7-13/14 in accordance with priorities based on WAG-wide concerns. Semiannual aquifer monitoring should also continue.

10.3.8 Protectiveness Statement

The remedy at Pad A currently protects human health and the environment and is functioning as intended in the ROD. Ongoing maintenance and institutional controls preclude prolonged direct contact with the waste. Current monitoring data indicate that the remedy is functioning as required to achieve cleanup goals. However, the Pad A remedy will be reevaluated based on cumulative impacts as part of the WAG 7 comprehensive OU 7-13/14 RI/FS and ROD.

10.4 Section 10 References

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11. WASTE AREA GROUP 9 (MATERIALS AND FUELS COMPLEX)

The Materials and Fuels Complex (MFC)—formerly ANL-W—was established in the 1950s to research and develop nuclear reactors and fuel. Since then, three reactors have been constructed at the MFC: the Transient Reactor Test Facility, EBR-II, and the Zero Power Physics Reactor. None of these reactors is currently operating, but past operations and support activities have resulted in chemical and radioactive contamination.

To facilitate cleanup of the contamination, the MFC was designated as WAG 9 under the FFA/CO (DOE-ID 1991). To ascertain the extent of this contamination, a comprehensive RI/FS was completed in October 1997. Thirty-seven sites, collectively designated as OU 9-04, were evaluated during the RI/FS. Five of the sites were found to pose unacceptable risks to human health and/or the environment. This CERCLA (42 USC § 9601 et seq.) remedial action is proceeding in accordance with the *Final Record of Decision Argonne National Laboratory-West, Operable Unit 9-04* (DOE, DEQ, and EPA 1998).

In order to effectively quantify the risks, two of the identified sites were subdivided into smaller areas because of the significantly different exposure pathways. The two sites that were subdivided are (1) the industrial waste pond and associated ditches, which were divided into three areas (industrial waste pond, Ditch A, and Ditch B), and (2) the interceptor canal, which was divided into two areas (canal and mound). Thus, a total of eight areas were identified in the OU 9-04 ROD (DOE, DEQ, and EPA 1998) as requiring remedial action.

Of the eight areas requiring remedial action, two posed unacceptable risks to humans, one posed unacceptable risks to humans and ecological receptors, and the remaining five posed unacceptable risks to ecological receptors only. The three sites that contained Cs-137 were the only MFC sites that posed a risk to human heath, and the sites that contained various inorganics posed unacceptable risks to the ecological receptors. Table 11-1 lists the MFC release sites that required remediation, the COCs at each site, and the cleanup goals for each site. Figure 11-1 shows the locations of the release sites at WAG 9 that required remediation. Risks from the remaining 32 sites were considered acceptable; thus, they required no further action.

Table 11-2 provides a chronology of significant events at WAG 9.

11.1 Remedial Actions

The following subsections describe the nature of, extent of, and remedial actions for the contamination at the eight CERCLA areas. These eight CERCLA areas pose unacceptable risks to human health and/or the environment. The eight areas were identified as containing hazardous substances that might endanger the public and/or environment if not addressed by actions identified in the ROD (DOE, DEQ, and EPA 1998).

11.1.1 Remedy Selection

The ROD (DOE, DEQ, and EPA 1998) identified phytoremediation as the selected remedy for OU 9-04 and identified excavation and disposal as the contingent remedy. The *Final Explanation of Significant Differences to the Record of Decision for Argonne National Laboratory-West Operable Unit 9-04* (ANL-W 2000) issued in February 2000 implemented the contingent remedy of excavation and disposal for two areas: Ditch B and the east portion of the main cooling tower blowdown ditch.

Table 11-1. Contaminants of concern at Operable Unit 9-04.

Site Code	Area	COC	95% UCL Concentration	Remediation Goal
ANL-01	Industrial waste pond	Chromium-III	1,030	50
		Mercury	2.62	0.74
		Selenium	8.41	3.4
		Zinc	5,012	2,200
		Cs-137	29.2	23.3
	Ditch A	Mercury	3.94	0.74
	Ditch B	Chromium	1,306	50
		Zinc	3,020	2,200
ANL-01A	Main cooling tower blowdown ditch	Chromium	709	50
		Mercury	8.83	0.74
ANL-04	Sewage lagoons	Mercury	3.2	0.74
ANL-09	Interceptor canal-canal	Cs-137	30.53	23.3
	Interceptor canal-mound	Cs-137	18	23.3
ANL-35	Industrial waste lift station discharge ditch	Silver	352	112

ANL = Argonne National Laboratory
COC = contaminant of concern
UCL = upper confidence limit

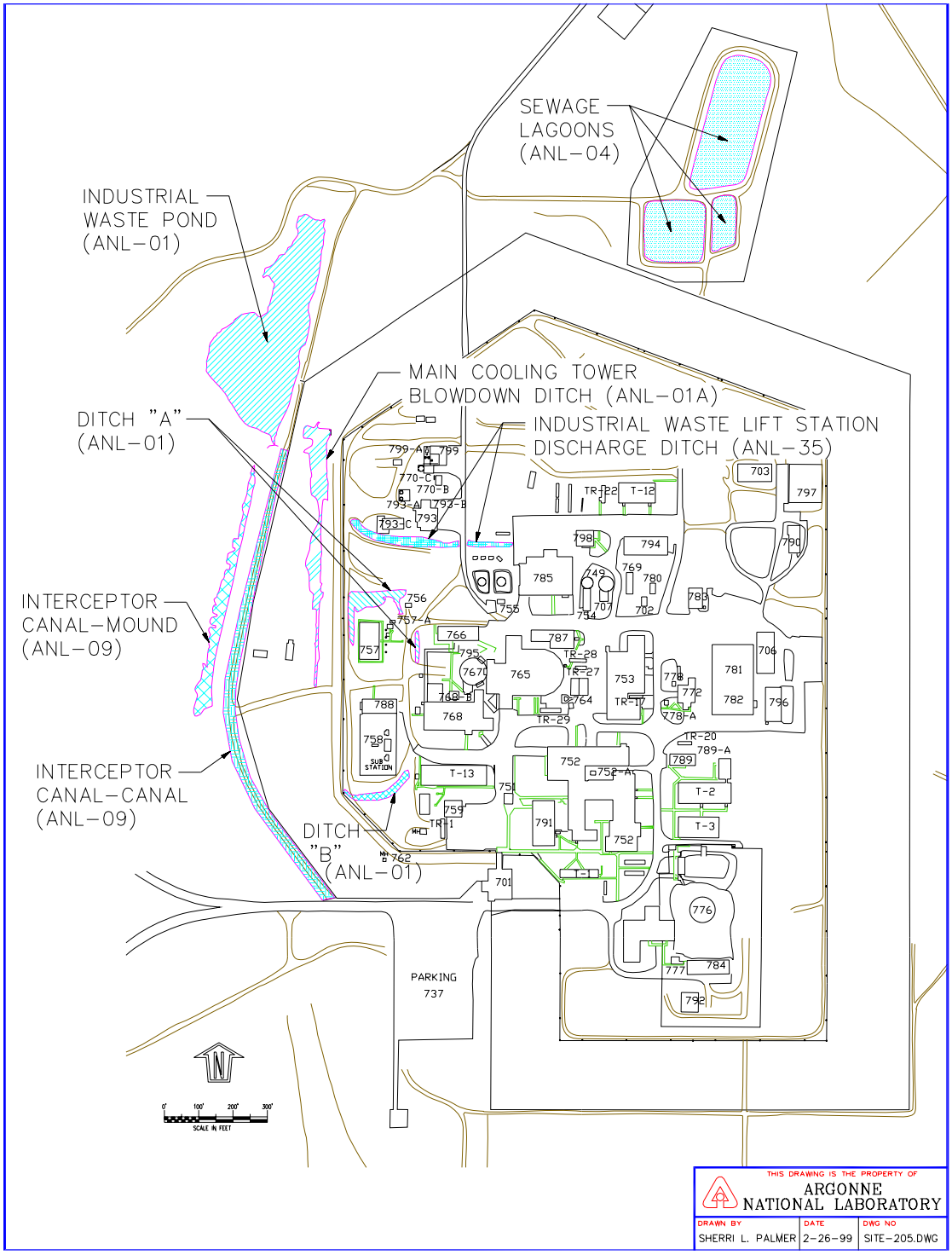

Figure 11-1. Areas that required remediation at the Materials and Fuels Complex.

Table 11-2. Chronology of the Waste Area Group 9 events.

Event	Date
The "Consent Order and Compliance Agreement" (EPA 1987) was signed.	July 28, 1986
The FFA/CO (DOE-ID 1991) for the INL Site was signed.	December 9, 1991
The *Comprehensive Remedial Investigation/Feasibility Study for the Argonne National Laboratory-West Operable Unit 9-04 at the Idaho National Engineering and Environmental Laboratory* (Lee et al. 1997) was completed.	December 1997
The *Final Record of Decision Argonne National Laboratory-West, Operable Unit 9-04* (DOE, DEQ, and EPA 1998) was completed.	September 29, 1998
Bench-scale phytoremediation testing was completed.	February 1999
The final *Remedial Design/Remedial Action Work Plan for the Argonne National Laboratory-West, Operable Unit 9-04* (ANL-W 1999) was completed.	August 1999
Implementation of phytoremediation began at four sites.	May 17, 1999
The *Final Explanation of Significant Differences to the Record of Decision for Argonne National Laboratory-West Operable Unit 9-04* (ANL-W 2000) to implement the contingent remedy of excavation and disposal at the CFA landfill was published.	February 2000
The *Phytoremediation 2-Year Field Season Demonstration Project Report, Argonne National Laboratory-West* (ANL-W 2001) was submitted to the regulatory agencies.	March 2001
The *Sampling and Analysis Plan for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2003) was submitted to the regulatory agencies.	July 2003

ANL-W = Argonne National Laboratory West
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
DEQ = [Idaho] Department of Environmental Quality
DOE = U.S. Department of Energy
DOE-ID = U.S. Department of Energy Idaho Operations Office
EPA = U.S. Environmental Protection Agency
FFA/CO = Federal Facility Agreement and Consent Order

The *Explanation of Significant Difference Argonne National Laboratory-West, Operable Unit 9-04* (DOE, DEQ, and EPA 2004) issued in 2004 implemented the contingent remedy of excavation and disposal for the industrial waste pond and hot spot removal in Ditch A and the industrial waste lift station discharge ditch. The one remaining area not yet undergoing remediation is the ANL-04 sanitary sewage lagoons. The remediation of that area is not scheduled to occur until its useful life is completed. Currently, the sanitary sewage lagoons are anticipated to remain in use until 2033.

11.1.2 Remedial Action Objectives

The RAOs for the eight areas of concern were developed in accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," and CERCLA RI/FS guidance through meetings with the DEQ, EPA, and DOE. The RAOs result from risk assessments and are specific to the COCs and exposure pathways developed for OU 9-04.

The RAO for protection of human health and safety is to inhibit direct exposure to radionuclide COCs in soil that would result in a total excess cancer risk of greater than 1 in 10,000 to 1,000,000 (1E-04 to 1E-06) to current and future workers and future residents.

The RAO for protection of the environment is to prevent exposure to COCs in soils that may have potential adverse effects to resident populations of flora and fauna, as determined by a hazard quotient equal to 10 times the hazard quotient calculated from INL Site background soil concentrations.

To meet these RAOs, PRGs were established. The goals are quantitative cleanup levels based primarily on ARARs and risk-based doses. Final remediation goals are based on the results of the baseline risk assessment and an evaluation of expected exposures and risks for selected alternatives. Table 11-1 presents the final remediation goals. Remedial actions were completed to ensure that risk would be mitigated and exposure would not exceed the final remediation goals.

11.1.3 Remedy Implementation

The following subsections describe the remedial actions implemented at the OU 9-04 sites. A full description of the remedial actions can be found in the *Final Remedial Design/Remedial Action Work Plan for the Argonne National Laboratory-West, Operable Unit 9-04* (ANL-W 1999) and the *Remedial Design Argonne National Laboratory-West, Operable Unit 9-04* (ANL-W 2004). In 1999, the first Remedial Design Work Plan document implemented phytoremediation on four areas and excavation and disposal of Ditch B and the east portion of the main cooling tower blowdown ditch. The 2004 Remedial Design Work Plan implemented excavation and disposal of the industrial waste pond and hot spot removal of soil in two previously phytoremediated sites (Ditch A and the industrial waste lift station discharge ditch).

11.1.3.1 Industrial Waste Pond (ANL-01 Site). The industrial waste pond sediments contained low levels of Cs-137 that pose unacceptable risks to humans. The pond sediments also contained four inorganics (i.e., chromium, mercury, selenium, and zinc) that posed unacceptable risks to ecological receptors. In 2004, the decision was made to implement the contingent remedy of excavation and disposal rather than phytoremediation at this site because of potential future projects at MFC. The excavation and disposal activities were completed in 2004 with the soil being transported to the ICDF. A total of 1,351 tons of soil was removed during the first campaign, and confirmation sampling indicated one hot spot remained for chromium that exceeded the remediation goal. Consequently, a second campaign of excavation and disposal was conducted in November 2004 and removed all of the soil from this hot spot down to the basalt. The hot spot removal resulted in 136 tons of soil that was transported to the ICDF in November 2004. The shipments of waste to the ICDF were tracked using Waste Profile 4243P in the IWTS.

Tables 20 and 24 of the *Data Quality Assessment Report for the Post-Remedial Action Confirmation Sampling of the ANL-W CERCLA Sites* (Portage 2005a) show the statistical calculation of each COC for the surface and subsurface soils, respectively. After remediation, each of the five contaminants were below the established remediation goals for the surface and subsurface data sets with the exception of chromium in the surface soils. The chromium in the surface soils had a mean concentration of 433 mg/kg and a calculated UCL of 626 mg/kg, which exceeded the 500-mg/kg remediation goal. However, the State of Idaho and EPA agreed that since the pond will continue to be used as a pond, no vegetation (bunch grass) could grow underwater; thus, no pathway exists.

11.1.3.2 Ditch A (ANL-01 Site). In May 1999, phytoremediation actions were initiated at Ditch A, which contained mercury contamination that posed an unacceptable risk to ecological receptors. Phytoremediation was estimated to take 7 years to meet the remediation goal of 0.74 mg/kg for mercury. Preliminary results from a two-field season showed that phytoremediation with hybrid willows and poplars was working better than expected and that remediation goals could be met after 4 years rather than the estimated 7 years.

Phytoremediation activities continued in 2001 and 2002, and confirmation samples were collected in 2003 and summarized in the *Data Quality Assessment Report for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2005b). The sampling results indicated that hot spots remained; therefore, the decision was made to implement the contingent remedy of excavation and

disposal in 2004. The excavation and disposal activities also were completed in 2004 with the excavated soil being transported to the CFA bulky waste landfill and placed at a depth greater than 10 ft to prevent exposure to ecological receptors. The 50 yd^3 of waste was tracked using Waste Profile 4428P in IWTS.

Tables 13 and 16 of the *Data Quality Assessment Report for the Post-Remedial Action Confirmation Sampling of the ANL-W CERCLA Sites* (Portage 2005a) show the statistical calculation of mercury for the surface and subsurface soils, respectively. The UCL values in the surface and subsurface soils were 0.64 mg/kg and 0.74 mg/kg, respectively, which are at or below the mercury remediation goal of 0.74 mg/kg.

11.1.3.3 Ditch B (ANL-01 Site). An ESD (ANL-W 2000) issued in February 2000 implemented the contingent remedy of excavation and disposal of the soil, rather than phytoremediation, at Ditch B. The excavation activities were conducted in June 2000 using front-end loaders and backhoes to remove the soil from the ditch down to the top of the basalt. Dump trucks moved the soil to the staging area. The soil was stockpiled near the ditch and covered with plastic material to prevent the spread of contamination from windblown dust, rainfall, and leachate. The soil remained at the stockpiled area until the soil could be accepted at a new waste cell in the CFA landfill. The soil was deposited in the bottom of the cell at a depth greater than 10 ft to prevent exposure to ecological receptors. Confirmation samples could not be collected because all the soil was removed. The 30 yd^3 of waste was tracked using Waste Profile 2550P in IWTS.

11.1.3.4 Main Cooling Tower Blowdown Ditch (ANL-01A Site). Remediation activities for this site were initiated in May 1999. The main cooling tower blowdown ditch was divided into two portions based on location. The east portion of the ditch is located near the cooling tower inside the MFC protection area. The west portion of the ditch is located between the inner and outer security fences. Contaminant concentrations for the soil in these two portions varied by orders of magnitude, and the selected remedy of phytoremediation would only work on the west portion. The east portion received the cooling tower discharge and had the highest contaminant concentrations, and the west portion had much lower concentrations and conveyed the effluent to the industrial waste pond. Because of the concentration differences between these two portions of the same CERCLA site, the decision was made to use excavation and disposal on the east portion and phytoremediation on the west portion.

The east portion of the main cooling tower blowdown ditch lies within the MFC security protection area and was the receiving location for water discharged from the cooling tower. For that portion of the ditch, the contingent remedy of excavation and disposal of the soils—rather than phytoremediation—was implemented in accordance with an ESD issued in February 2000 (ANL-W 2000). The excavation activities were conducted in May 2000 using front-end loaders and backhoes to remove soil from the ditch down to a depth of 2 ft. The soil was stockpiled with the Ditch B soil and covered with plastic material to prevent the spread of contamination from windblown dust, rainfall, and leachate. Soil samples indicated that the remediation goals had not been achieved, and additional soil was removed to basalt (approximately 6 ft) in June 2000. The 130 yd^3 of stockpiled soil was disposed of at the CFA landfill in July using IWTS Profile 2550P. The soil was placed in the bottom of the CFA landfill cell at a depth greater than 10 ft to prevent exposure to ecological receptors. Confirmation sampling results were not collected, because no soil existed above basalt and the ditch was backfilled with clean soil to grade.

Phytoremediation actions were initiated at the west portion of the main cooling tower blowdown ditch in May 1999. Initial activities included removal of soil from the area inside the two security fences and placing the soil inside the MFC controlled area. That action was necessary, because trees growing in the security area could have potentially provided concealment of threats to MFC. Phytoremediation was estimated to take 7 years to meet the remediation goals of 500 mg/kg and 0.74 mg/kg for chromium and mercury, respectively. The results after the first 2 years of implementation showed that phytoremediation

using the hybrid willows and poplars was working better than expected and remediation goals could be met after 4 years rather than the estimated 7 years. Phytoremediation activities continued in 2001 and 2002, and confirmation samples were collected in 2003. Tables 5 and 9 of the *Data Quality Assessment Report for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2005b) show the UCL values for chromium and mercury in the surface and subsurface soils, respectively. The UCLs for surface samples and subsurface for chromium were 54.8 mg/kg and 61 mg/kg, respectively, well below the remediation goal of 500 mg/kg. The UCL for mercury in the surface and subsurface was 0.42 mg/kg and 0.37 mg/kg, respectively, both below the remediation goal of 0.74 mg/kg.

11.1.3.5 Sanitary Sewage Lagoons (ANL-04 Site). The sanitary sewage lagoons contain mercury that poses an unacceptable risk to the ecological receptors. The OU 9-04 ROD (DOE, DEQ, and EPA 1998) delayed remediation of the sanitary sewage lagoons until the end of the useful life of the lagoons, which was anticipated to be in 2033. The selected remedy in the OU 9-04 RI/FS was phytoremediation with the contingent remedy of excavation and disposal.

Because the sanitary sewage lagoons will continue to be flooded by wastewaters in the foreseeable future, it is unlikely that the ecological receptor identified in the OU 09-04 ROD (i.e., Merriams shrew) will interact with the contaminated soil present in the bottom of the lagoons.

11.1.3.6 Interceptor Canal-Mound (ANL-09 Site). Phytoremediation actions were initiated at the interceptor canal-mound in May 1999. Phytoremediation was estimated to take 7 years to meet the remediation goal of 23.3 pCi/g. Results documented in the *Phytoremediation 2-Year Field Season Demonstration Project Report, Argonne National Laboratory-West* (ANL-W 2001) showed that phytoremediation using an annual planting of 750,000 kochia scoparia plants was working better than expected and that remediation goals could be met after 4 years rather than the estimated 7 years. The phytoremediation activities were again initiated for the 2001 and 2002 field seasons. After each field season, plant matter was collected, compacted, sampled, and placed into waste boxes. After 4 years of phytoremediation, the 10.6 yd^3 of waste was transported to the RWMC for disposal as low-level waste using IWTS Profile 2334P. Sample results of soil taken in 2003 indicate that the Cs-137 concentration was below the established remediation goal. Tables 14 and 18 of the *Data Quality Assessment Report of the Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2005b) compare the surface and subsurface soils to the remediation goal. The UCLs for the surface and subsurface Cs-137 were 9.54 pCi/g and 2.48 pCi/g, respectively, well below the 23.3-pCi/g remediation goal. However, because the Cs-137 concentrations were greater than those that are acceptable for the occupational receptors, the site will remain under institutional controls until the levels decay to 2.3 pCi/g.

11.1.3.7 Interceptor Canal-Canal (ANL-09 Site). The interceptor canal-canal contains low levels of Cs-137 that pose unacceptable risks to humans for the occupational receptor scenario. The concentration of Cs-137 was found to be 18 pCi/g, which is below the established remediation goal for free release of 23.3 pCi/g. This site will remain under institutional controls. The Cs-137 contamination will decay to background levels in 2085. Thus, this site requires no remediation other than institutional controls and to continue completion of the five-year reviews.

11.1.3.8 Industrial Waste Lift Station Discharge Ditch (ANL-35 Site). Phytoremediation actions were initiated at the industrial waste lift station discharge ditch in May 1999. This site was remediated because of silver contamination that posed unacceptable risks to the ecological receptors. Initially, phytoremediation was estimated to take 7 years to meet the remediation goal of 112 mg/kg. Results of the *Phytoremediation 2-Year Field Season Demonstration Project Report* (ANL-W 2001) showed that phytoremediation with hybrid willows and poplars was working better than expected and remediation goals could be met after 4 years. Phytoremediation activities continued for the 2001 and 2002 field seasons with confirmation samples collected in 2003. Tables 22 and 26 of the *Data Quality*

Assessment Report for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites, Argonne National Laboratory-West (Portage 2005b) show the surface and subsurface UCLs and remediation goal for silver. As shown, the UCL of 104 mg/kg for silver in the surface and 55.4 mg/kg for silver in the subsurface are below the remediation goal of 112 mg/kg. However, data indicated that a hot spot near the surface contributed significantly to the statistics and additional remediation was warranted.

As such, the decision was made to implement the contingent remedy of excavation and disposal in the 2004 ESD (DOE, DEQ, and EPA 2004). The excavation and disposal activities were conducted in the summer of 2004. Tables 5 and 9 of the *Data Quality Assessment Report for the Post-Remedial Action Confirmation Sampling of the ANL-W CERCLA Sites* (Portage 2005a) show that the UCL for silver in the surface was 191 mg/kg and the UCL for silver in the subsurface was 32.3 mg/kg, while the remediation goal was 112 mg/kg. Thus, the surface soil exceeded the remediation goal, and further excavation was warranted.

Consequently, in October 2004, the area with highest silver results was excavated to basalt. Approximately 100 yd^3 of soil from the excavation events in 2004 was shipped and disposed of at the CFA bulky waste landfill. That soil was placed at a depth greater than 10 ft to prevent exposure to ecological receptors. Confirmation samples were not collected after the removal, because all soil in the targeted area was removed to basalt.

11.2 Data Evaluation

The OU 9-04 ROD (DOE, DEQ, and EPA 1998) stated that monitoring of the soil, groundwater, and vegetation will continue until 2018. Results from the sampling are submitted annually to the DOE contractor for incorporation into the INL annual site report. The most recent annual monitoring report is for calendar year 2003 and can be found at http://www.stoller-eser.com/annuals/2003. Review of these results indicates that soil or vegetation results have not increased from those levels recorded in 1998 and are well below the levels defined as hazardous waste.

The MFC groundwater monitoring program consists of one upgradient well and three downgradient wells. In addition, one production well is sampled from within the MFC security area. All wells are sampled twice annually—typically in April and October. Review of the groundwater data indicates that 22 occurrences were above the drinking water maximum contaminant levels (DWMCLs) from 1998 through 2004. The data for the 22 occurrences are shown in Table 11-3. The results for the upgradient monitoring well (ANL-MON-A-012) showed aluminum and thallium above the DWMCLs; aluminum, thallium, iron, sodium, lead, and nitrate were detected in the downgradient wells. None of these contaminants were COCs for the CERCLA sites. These data do not show a consistent pattern of increased trends and appear to be sampling anomalies. The one exception, however, is the sodium in ANL-MON-A-013, in which the sodium levels stay slightly above the MCL. Sodium, considered a secondary DWMCL, can cause problems for some individuals, but no receptor is currently drinking that water. ANL-MON-A-013 is used to monitor the industrial waste pond, and elevated levels of sodium are expected.

The groundwater level in the one upgradient and three downgradient wells has dropped approximately 12 ft since 1998. This drop has caused significant problems in the collection of samples. In May 2002, water samples could not be collected from the M-12 well, because the inlet to the pump was above the water table. In October 2002, the M-11 and M-12 wells could not be sampled because of a continued drop in the water table. As a result, all of the pumps for the four monitoring wells were lowered to within 1 ft of the bottom. In April 2004, water samples could not be collected from the M-11 well, because the water dropped below the pump inlet. This well was redrilled and lowered 50 ft. Continued

Table 11-3. Materials and Fuels Complex groundwater values exceeding drinking water maximum contaminant levels.

Well Location	Analyte	Value (mg/L)	DWMCLs (mg/L)	Sample Date	Sample Number	Laboratory Qualifiers[a]
ANL-MON-A-011	Iron	3.63	0.3	03/23/1999	AGW07501-C4/MW-11	—
ANL-MON-A-011	Iron	0.618	0.3	08/7/2001	ANL-206-01C4	—
ANL-MON-A-011	Thallium	0.0043	0.002	05/9/2002	ANL-104-02-C4	B
ANL-MON-A-012	Aluminum	0.0568	0.05	03/22/1999	AGW07601-C4/MW-12	B
ANL-MON-A-012	Aluminum	0.182	0.05	04/23/2001	ANL-006-01C4	B
ANL-MON-A-012	Thallium	0.0043	0.002	05/8/2002	ANL-072-02-C4	B
ANL-MON-A-012	Thallium	17.9	0.002	04/21/2003	ANL-008-03	B
ANL-MON-A-013	Sodium	21.9	20	10/12/1999	MW-13	—
ANL-MON-A-013	Sodium	21.3	20	06/27/2000	ANL-102-00C4	—
ANL-MON-A-013	Sodium	21.3	20	10/9/2000	ANL-217-00C4	—
ANL-MON-A-013	Sodium	20.4	20	04/23/2001	ANL-020-01C4	—
ANL-MON-A-013	Iron	0.479	0.3	10/7/2003	ANL-188-03	—
ANL-MON-A-013	Aluminum	0.0893	0.05	04/20/2004	07604	—
ANL-MON-A-013	Iron	0.363	0.3	04/20/2004	07604	—
ANL-MON-A-014	Lead	0.0162	0.015	01/29/1997	AGW03501C4	S
ANL-MON-A-014	Nitrate	137	10	01/29/1997	AGW03501ND	—
ANL-MON-A-014	Iron	0.69	0.3	03/23/1999	AGW07801-C4/MW-14	—
ANL-MON-A-014	Thallium	0.0031	0.002	10/12/1999	MW-14	—
ANL-MON-A-014	Aluminum	0.0751	0.05	10/16/2000	ANL-244-00C4	B
ANL-MON-A-014	Iron	0.375	0.3	05/8/2002	ANL-115-02-C4	—
ANL-MON-A-014	Thallium	0.0034	0.002	05/8/2002	ANL-115-02-C4	B
EBR-II #2	Aluminum	0.0975	0.05	04/25/2001	ANL-051-01C4	B

a. The B-reported value was obtained from a reading that was less than the contract-required detection limit but greater than the instrument detection limit. The S-reported value was determined by the method of standard additions.

ANL = Argonne National Laboratory
DWMCL = drinking water maximum contaminant level

drought and upgradient use of the groundwater by irrigators are being blamed on the drop in the water table below MFC. If the trend continues, the M-13 well will have to be redrilled and the pump lowered in order for water samples to be collected.

11.3 Progress since Last Review

This is the first five-year review of OU 9-04.

11.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

The functional status of the remedy for each of the OU 9-04 areas is provided in Table 11-4. For seven areas, the remedial action is complete, with the final signatures on the remedial action report pending. For three of these areas, continued institutional controls are required because of remaining concentrations of Cs-137. The institutional controls to prevent inadvertent access to these three areas have been implemented and are functioning as originally intended. At the three sites that contain Cs-137, institutional controls will continue until the levels reach the INL Site background of 2.3 pCi/g. Table 11-4 summarizes the responses to the functionality of the OU 9-04 remedies as of September 2004.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?*

Of the toxicological criteria for COCs at OU 9-04, none has undergone any major revisions or updates that would decrease the final remediation goals. Therefore, once met, the final remediation goals (site-specific, risk-based cleanup levels) will remain protective of human health and the environment under current exposure scenarios. Monitoring results show that the contaminant concentrations are well below the established final remediation goals.

The original assumptions, cleanup levels, and RAOs used at the time of the remedy selection are still valid. Successful implementation of the phytoremediation and/or excavation and disposal remedies has reduced the concentrations of Cs-137 and inorganic contaminants to levels that are acceptable to humans and the ecological receptors.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No.

11.5 Technical Assessment Summary

Remedial actions have been completed in accordance with the decision documents at the ANL-01, ANL-01A, ANL-09, and ANL-35 sites. Based on the available data, the remedial actions at the sites were completed successfully and the remedies are functioning as intended. The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selections are still valid, and no new information has come to light that could call into question the protectiveness of the remedies. In addition to the remediation of these sites, institutional controls have been implemented at the industrial waste pond (ANL-01) and at both areas within ANL-09 (interceptor canal-canal and interceptor canal-mound) and are functioning as required.

Table 11-4. Summary of responses to Question A.

Site	Area	Remedy	Remedial Action Complete	Remedy Functioning (as documented in remedial action report)
ANL-01	Industrial waste pond	Soil excavation	Yes—2004, except for the remedial action report	Pending (only institutional controls are required)
	Ditch A	Phytoremediation then soil excavation	Yes—2004, except for the remedial action report	Pending
	Ditch B	Soil excavation	Yes—2004, except for the remedial action report	Pending
ANL-01A		Phytoremediation	Yes—2004, except for the remedial action report	Pending
ANL-04	Sewage lagoons	Phytoremediation with contingent excavation and disposal	No—In 2005, this site is being moved to OU 10-08.	NA (transferred to OU 10-08)
ANL-09	Interceptor canal-canal	Phytoremediation	Yes—2004, except for the remedial action report	Pending (only institutional controls are required)
ANL-35	Interceptor canal-mound	Natural attenuation	Yes—2004	Pending (only institutional controls are required)
	Industrial waste lift station discharge ditch	Phytoremediation then soil excavation	Yes—2004, except for the remedial action report	Pending

ANL = Argonne National Laboratory
NA = not applicable
OU = operable unit

11.6 Issues

No issues have been identified during the ongoing OU 9-04 remedial action activities that have not been resolved through the two ESDs (ANL-W 2000; DOE, DEQ, and EPA 2004).

11.7 Recommendations and Follow-up Actions

As discussed in the OU 9-04 ROD, remedial actions for the sanitary lagoons (ANL-04) were delayed until the end of their useful lives. However, because the mission of MFC has changed, the sewage lagoons are scheduled to receive discharge until approximately 2033 in support of continued activities at the MFC. Because remedial actions have been completed at all of the CERCLA sites at WAG 9, it is recommended that the ANL-04 be transferred to OU 10-08, thus allowing the closure of WAG 9.

11.8 Protectiveness Statement

Remedial actions have been completed at seven of the eight areas identified in the OU 9-04 ROD (DOE, DEQ, and EPA 1998). These seven areas are awaiting final regulatory approval of the *Remedial Action Report for Waste Area Group 9, Operable Unit 9-04 at the Idaho National Engineering and Environmental Laboratory* (Portage 2005c). The remaining area that has not undergone remediation activities is the sanitary sewage lagoon site, which is being transferred to OU 10-08. This five-year review is being used to officially document the transfer of the sanitary sewage lagoons to OU 10-08, as discussed in Ceto (2005) and Faulk (2005). The remedies on the remaining areas at OU 9-04 are protective of human health and the environment.

11.9 Section 11 References

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Portage, 2003, *Sampling and Analysis Plan for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites*, Portage-03/001, Rev. 2, Portage Environmental, Inc., July 2003.

Portage, 2005a, *Data Quality Assessment Report for the Post-Remedial Action Confirmation Sampling of the ANL-W CERCLA Sites*, 04-015, Rev. 1, Portage Environmental, Inc., January 2005.

Portage, 2005b, *Data Quality Assessment Report for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites*, 04-011, Rev. 1, Portage Environmental, Inc., January 2005.

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12. WASTE AREA GROUP 10 (SITEWIDE AREA)

WAG 10 comprises miscellaneous surface sites and liquid disposal areas throughout the INL Site that are not included within other WAGs (WAGs 1 through 9). WAG 10 also includes INL Site-related concerns about the SRPA that cannot be addressed on a WAG-specific basis.

The scope of WAG 10 was expanded from the original FFA/CO concept (DOE-ID 1991). Several new sites have been identified and a facility assessment has been completed since the initial signing of the INL Site FFA/CO, as discussed in the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001). Other changes in scope have resulted in the creation of OU 10-08 within WAG 10 to evaluate INL Site groundwater concerns. The WAG 6 comprehensive RI/FS (OU 6-05) was incorporated into OU 10-04 in accordance with the FFA/CO (DOE-ID 1991).

The FFA/CO originally identified 42 release sites under WAG 10, which were separated into one no-action OU (called "OU none") and five action OUs (10-01 through 10-05). Since the initial preparation of the FFA/CO, however, additional sites and three OUs (10-06 through 10-08) have been added to WAG 10.

OU 10-01 contained two disposal pits: the Liquid Corrosive Chemical Disposal Area (LCCDA)-01, which operated between 1960 and about 1971, and LCCDA-02, which operated from about 1970 until the area was closed in 1981 (EG&G 1986). The LCCDA, which is located approximately 0.6 mi east of the main RWMC entrance, was used to dispose of solid and liquid corrosive chemicals such as nitric acid, sulfuric acid, and sodium hydroxide. The LCCDA-01 and LCCDA-02 sites were retained for evaluation in the OU 10-04 comprehensive RI/FS because of uncertainties attributed to the limited number of samples collected for the Track 2 investigations.

Included in OU 10-02 was the Organic-Moderated Reactor Experiment (OMRE) leach pond, which was used for wastewater disposal from the OMRE reactor. The reactor operated between 1957 and 1963 in the southern portion of the INL Site, approximately 2 mi east of the CFA. Between 1 and 2 million gal of radioactive wastewater, possibly contaminated with organic coolant and decomposition waste, are estimated to have been discharged to the pond, where the water either evaporated or infiltrated into the ground. The leach pond area underwent D&D in 1978, when it was remediated by excavating the more contaminated soil and then filling the pond with clean soil. The site was retained for further evaluation under the OU 10-04 comprehensive RI/FS.

The ordnance areas at the INL Site were addressed in OU 10-03 and included 29 areas (including the Naval Ordnance Disposal Area [NODA]) that contained ordnance or explosives-contaminated soil. Walk-downs of the ordnance sites occurred from 1993 through 1997 and in 2000 in search of unexploded ordnance (UXO). An interim action commenced in 1993 to address six of the ordnance areas originally identified under OU 10-03 and designated as OU 10-05. Twenty-seven of the 29 ordnance areas were retained for evaluation under the OU 10-04 comprehensive RI/FS.

OU 10-04 includes the SRPA and two sites identified at the STF, including the STF-601 sump and pits and the STF gun range. Although the SRPA was originally part of OU 10-04, it will be evaluated in the OU 10-08 RI/FS. The WAG 10 sites (Figure 12-1) assessed under the comprehensive OU 10-04 RI/FS included 27 sites consisting of 10 miscellaneous sites, two sites at the LCCDA, one site at the OMRE, two sites at the STF, three large (primary) ordnance areas (one of that included 16 smaller ordnance areas), nine ordnance areas either outside the boundaries of the larger ordnance areas or containing soil contamination, and the fly ash pit (added to OU 10-04 for an ecological risk assessment).

The three primary ordnance areas include the Naval Proving Ground (also know as the Naval Gun Range), the Arco High-Altitude Bombing Range, and the Twin Buttes Bombing Range. Most of the ordnance, UXO, and ordnance-related areas at the INL Site resulted from ordnance testing, demolition of explosives, and bombing practice conducted during the 1940s, when a portion of the INL Site was a naval proving ground.

Table 12-1 lists the COCs and corresponding remediation goals for OU 10-04 sites requiring cleanup. Note that the UXO sites, while requiring remediation for the ordnance, do not have remediation goals listed, because UXO does not pose a hazard to human health and the environment in terms normally considered for sites requiring remediation; instead, the UXO in these areas presents an unacceptable risk of acute physical injury from fire or explosion.

OU 10-05 was cited in the FFA/CO (DOE-ID 1991) as the "Ordnance Interim Action." The six sites covered by OU 10-05 are a subset of the ordnance sites evaluated under OU 10-03. The sites consisted of the CFA gravel pit, the explosive storage bunkers north of INTEC, the NOAA grid, the CFA-633 naval firing site and downrange area, the Fire Station II zone and range fire burn area, and the Anaconda power line. The *Declaration of the Record of Decision Ordnance Interim Action Operable Unit 10-05 Waste Area Group 10 Idaho National Engineering Laboratory* (DOE-ID 1992) was signed in 1992, and the interim action was completed in 1994, as reported in the *Preliminary Scoping Track 2 Summary Report for Operable Unit 10-03 Ordnance* (DOE-ID 1998).

OU 10-06 was developed to assess radionuclide-contaminated soil areas at several of the WAGs. OU 10-06 also included a non-time-critical removal action to remediate several radionuclide-contaminated soil sites at different WAGs. The "ownership" of the sites outside of WAGs 6 and 10 reverted to the respective WAGs after the OU 10-06 non-time-critical removal action was completed. The residual risk at the two WAG 6 sites that were remediated under OU 10-06 (the EBR-15 and BORAX-08 sites) also was evaluated in the comprehensive RI/FS for WAGs 6 and 10 (DOE-ID 2001).

OU 10-07 comprises the U.S. West buried telecommunications cable that was installed by the American Telephone and Telegraph Company (AT&T) in the early 1950s. The cable is approximately 36.5 mi long and is buried approximately 3 to 4 ft deep, parallel to and approximately 100 yd east of Lincoln Boulevard at the INL Site. The cable consists of copper wiring, paper insulation, and lead sheathing approximately 1/8-in. thick. It is wrapped in spiraled steel and enclosed in jute wrapping impregnated with an asphalt-like substance. The cable originates at CFA and extends along Lincoln Boulevard to INTEC, the RTC (formerly the TRA), the NRF, and TAN. The cable was cut and abandoned by U.S. West in 1990, and a new fiber optic cable was installed.

OU 10-08 includes INL-related concerns about the SRPA that cannot be addressed on a WAG-specific basis. With concurrence from the DOE, EPA, and DEQ, OU 10-08 also includes new sites discovered at other WAGs after their RODs have been signed and if the site cannot be addressed by an existing remedy. As provided in the *Waste Area Group 10, Operable Unit 10-08 Remedial Investigation/Feasibility Study Work Plan (Final)* (DOE-ID 2002a), the OU 10-08 ROD will be the final decision document to be prepared under the terms of the FFA/CO (DOE-ID 1991). The draft OU 10-08 RI/FS work plan is to be submitted to the EPA and DEQ within 15 months of the signature date for the final site-specific ROD (currently the OU 7-13/14 ROD) with the draft OU 10-08 RI/FS to be completed within 24 months of the final site-specific ROD. The current enforceable date for submittal of the draft OU 7-13/14 ROD is December 2007 with signature to follow approximately 6 months after in order to allow for reviews of the draft and draft final versions of the document.

Table 12-2 provides a chronology of significant events at WAG 10.

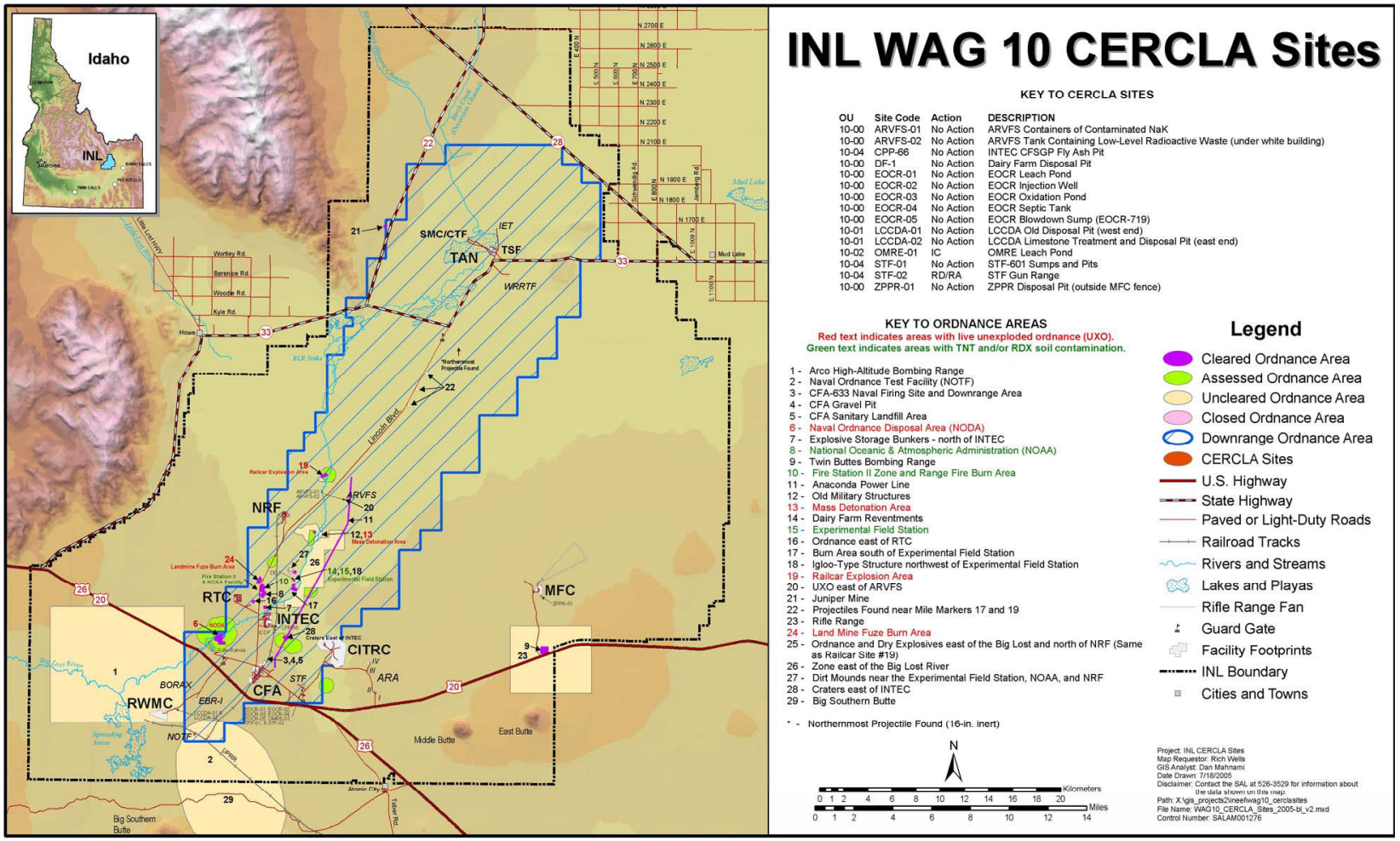

Figure 12-1. Waste Area Group 10 CERCLA sites.

Table 12-1. Contaminants of concern for Operable Unit 10-04.

Site (Site Code)	Contaminant	Concentration	Remediation Goal
STF Gun Range (STF-02)	Lead	Maximum 24,000 mg/kg	400 mg/kg
Arco High-Altitude Bombing Range (ORD-01)	UXO	NA	NA
Naval Ordnance Disposal Area 2 (ORD-06)	RDX	Maximum 328 mg/kg	4.4 mg/kg
	UXO	NA	NA
National Oceanic and Atmospheric Administration (ORD-08)	1,3-Dinitrobenzene	Maximum 27 mg/kg	6.1 mg/kg
	RDX	95% UCL, 1.78 mg/kg	4.4 mg/kg
	TNT	95% UCL, 1,900 mg/kg	16 mg/kg
	UXO	NA	NA
Twin Buttes Bombing Range (ORD-09)	UXO	NA	NA
Fire Station II Zone and Range Fire Burn Area (ORD-10)	RDX	Maximum 3.7 mg/kg	4.4 mg/kg
	TNT	Maximum 130 mg/kg	16 mg/kg
Mass Detonation Area (ORD-13)	UXO	NA	NA
Experimental Field Station (ORD-15)	1,3-Dinitrobenzene	Maximum 14 mg/kg	6.1 mg/kg
	TNT	Maximum 1,100 mg/kg	16 mg/kg
	UXO	NA	NA
Rail Car Explosion Area (ORD-19)	UXO	NA	NA
Land Mine Fuze Burn Area (ORD-24)	TNT	Maximum 79,000 mg/kg	16 mg/kg
	UXO	NA	NA

NA = not applicable
RDX = cyclotrimethylene trinitroamine
STF = Security Training Facility
TNT = trinitrotoluene
UCL = upper confidence limit
UXO = unexploded ordnance

Table 12-2. Chronology of Waste Area Group 10 events.

Event	Date
The Naval Proving Ground was established.	1942
The testing of guns commenced.	November 20, 1943
The OMRE reactor began operations.	September 17, 1957
The Experimental Organic-Cooled Reactor was placed in standby status (never operated).	December 1962
OMRE operations ceased.	April 1963
The *Declaration of the Record of Decision Ordnance Interim Action Operable Unit 10-05 Waste Area Group 10 Idaho National Engineering Laboratory* (DOE-ID 1992) was completed.	1992
The *Engineering Evaluation/Cost Analysis (EE/CA) for Non-Time-Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL), Operable Unit (OU) 10-03* (INEL 1994a) was completed.	April 1994
The *Remedial Action Report for the Interim Action to Cleanup Unexploded Ordnance Locations at the INEL (Operable Unit 10-05)* (Wyle 1994) was completed.	May 1994
The *Department of Energy Idaho Field Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL)* (DOE-ID 1994a) was completed.	June 1994
The *Engineering Evaluation/Cost Analysis for a Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil at the Idaho National Engineering Laboratory* (INEL 1994b) was completed.	June 1994
The *Department of Energy Idaho Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil, Idaho National Engineering Laboratory* (DOE-ID 1994b) was completed.	July 1994
The *Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995a) was completed.	March 1995
The *Addendum to the Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995b) was completed.	October 1995
The *U.S. Department of Energy, Idaho Operations Office Lead Agency Action Memorandum Time-Critical Removal Action Ordnance Areas Operable Unit 10-03 Idaho National Engineering Laboratory (INEL)* (DOE-ID 1996) was completed.	September 1996
The *Final Action Report for the Time Critical Removal Action, Operable Unit 10-03* (Parsons 1997) was completed.	January 1997
The *Engineering Evaluation Cost Analysis for Nontime-Critical Removal Action for Unexploded Ordnance at the Idaho National Engineering and Environmental Laboratory Operable Unit 10-03* (DOE-ID 1997) was completed.	June 1997
The *Summary Report for the 1997 Non-Time Critical Removal Action for Ordnance at Operable Unit 10-03* (INEEL 1999) was completed.	January 1999
The *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001) was completed.	August 2001

Table 12-2. (continued).

Event	Date
The *Waste Area Group 10, Operable Unit 10-08, Remedial Investigation/Feasibility Study Work Plan (Final)* (DOE-ID 2002a) was completed.	August 2002
The *Record of Decision – Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites* (DOE-ID 2002b) was completed.	November 2002
The *Operable Units 6-05 and 10-04, Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2003a) was completed.	February 2003
The *U.S. Department of Energy Idaho Operations Office, Lead Agency Action Memorandum Time-Critical Removal Action for Unexploded Ordnance, Operable Unit 10-04, Idaho National Engineering and Environmental Laboratory* (INEEL 2003a) was completed.	February 2003
The *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a) was completed.	February 2004
The *Summary Report for the 2004 Time-Critical Removal Action for Unexploded Ordnance at Operable Unit 10-04* (ICP 2004) was completed.	July 2004
The *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase II* (DOE-ID 2004b) was completed.	August 2004
The *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005a) was completed.	January 2005

DOE-ID = U.S. Department of Energy Idaho Operations Office
EE/CA = engineering evaluation/cost analysis
ICP = Idaho Cleanup Project
INEEL = Idaho National Engineering and Environmental Laboratory
INEL = Idaho National Engineering Laboratory
ORME = Organic-Moderated Reactor Experiment
OU = operable unit
RDX = cyclotrimethylene trinitroamine
TNT = trinitrotoluene

12.1 Remedial Actions

WAG 10 has completed one ROD with an interim action, four time-critical removal actions, one non-time-critical removal action, and Phase I of four phases to be completed under the OU 10-04 comprehensive ROD. In 1992, the *Declaration of the Record of Decision Ordnance Interim Action Operable Unit 10-05 Waste Area Group 10 Idaho National Engineering Laboratory* (DOE-ID 1992) under OU 10-05 addressed the remediation of 170 acres at six ordnance sites consisting of the CFA-633 naval firing site, the CFA gravel pit and French drain, the explosive storage bunkers, the NOAA site, the Fire Station II zone and range fire burn area, and the Anaconda power line. During the interim action prescribed by the ROD, the action destroyed 130 pieces of UXO, detonated 134 lb of trinitrotoluene (TNT) and 104 lb of cyclotrimethylene trinitroamine (RDX), incinerated (off-Site) 185 yd^3 of contaminated soil, and landfilled 8,423 lb of metal fragments.

A 1994 non-time-critical removal action addressed 141 acres consisting of three ordnance sites, including NODA (surface only), the CFA landfill, and the Twin Buttes Bombing Range. The action destroyed 1,408 pieces of UXO, detonated 22 lb of bulk high explosives, and landfilled 70,440 lb of metal fragments. The 1994 non-time-critical removal action continued into 1995, when it addressed 22.56 acres of subsurface ordnance at NODA. The 1995 action destroyed 462 pieces of UXO, detonated 18 lb of bulk high explosives, and landfilled 39,470 lb of metal fragments.

A 1996 time-critical removal action addressed 45 acres consisting of four ordnance sites, including UXO east of the RTC, the rail car explosion area, the land mine fuze burn area, and the projectiles in the riverbed adjacent to the rail car area. The action destroyed 221 pieces of UXO, detonated 64 lb of bulk high explosives, and landfilled 40,250 lb of metal fragments.

A 1997 non-time-critical removal action addressed 204 acres at eight ordnance sites: NODA, the rail car explosion area, the mass detonation area, the NOAA site, the Experimental Field Station, Fire Station II, the craters east of INTEC, and the land mine fuze burn area. The action destroyed 146 pieces of UXO, detonated 343 lb of bulk high explosives, and landfilled 40,182 lb of scrap.

A 2004 time-critical removal action addressed the removal and disposal by detonation of 66 pieces of UXO found at NODA and east of INTEC. The action destroyed 55 5-in. anti-aircraft common rounds and 11 fuzes.

Phase I of the *Record of Decision – Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites* (DOE-ID 2002b) established institutional controls at 28 WAG 10 sites across the INL Site that have been contaminated by various means, including operations and activities associated with the testing of ordnance and explosives. The WAG 10 sites addressed under OU 10-04 include miscellaneous INL sites such as the OMRE leach pond; the sites related to the Experimental Organic-Cooled Reactor (EOCR), which later became the STF; and numerous ordnance areas. In addition, the Phase I remedial action included development of a comprehensive INL Sitewide approach for establishing, implementing, enforcing, and monitoring institutional controls and implementing a long-term comprehensive approach for ecological monitoring to ensure protection of the ecosystem at the INL Site.

Details of the interim action, time-critical removal actions, non-time-critical removal actions, and Phase I of the comprehensive ROD are described below. Because fieldwork associated with Phases II, III, and IV of the OU 10-04 comprehensive ROD has not yet taken place, any discussion pertaining to these phases is deferred to the next five-year review with the exception of a discussion in Section 12.3, "Progress since Last Review."

12.1.1 Remedy Selection

12.1.1.1 Operable Unit 10-05 Interim Action. As outlined in the *Declaration of the Record of Decision Ordnance Interim Action Operable Unit 10-05 Waste Area Group 10 Idaho National Engineering Laboratory* (DOE-ID 1992), the selected remedy for the interim remedial action included the following actions:

- A comprehensive search of historical records pertaining to the Naval Proving Ground and other suspected ordnance sites at the INL Site
- Posting of signs where the public has access to ordnance areas
- A field search of the six identified areas for UXO
- Controlled detonation of the ordnance
- Field sampling of detonation areas and other areas suspected of contamination with explosive compounds

- Excavation of contaminated soils exceeding action levels

- Off-Site incineration and disposal of contaminated soils.

This alternative was preferred over the others outlined in the ROD, because it best achieved the goals of the evaluation criteria, given the scope of the action.

12.1.1.2 1994 Non-Time-Critical Removal Action. A non-time-critical removal action was conducted in 1994 under OU 10-03. The governing documents for the action were as follows:

- *Department of Energy Idaho Field Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL)* (DOE-ID 1994a)

- *Engineering Evaluation/Cost Analysis (EE/CA) for Non-Time-Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL), Operable Unit (OU) 10-03* (INEL 1994a)

- *Department of Energy Idaho Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil, Idaho National Engineering Laboratory* (DOE-ID 1994b)

- *Engineering Evaluation/Cost Analysis for a Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil at the Idaho National Engineering Laboratory* (INEL 1994b)

The three TNT- and RDX-contaminated soil sites addressed under the action included the CFA-633 naval firing site, the NOAA area, and the Fire Station II area. The three UXO sites included a 40-acre area within NODA, a 90-acre area within the former Twin Buttes Bombing Range, and four 16-in. shells located east of Lincoln Boulevard near Mile Marker 17. For the UXO, the primary objective of the removal action was to mitigate the hazard of uncontrolled detonation of ordnance to site workers, facilities, and public roads. A secondary objective of the removal action was to provide information for planning and conducting the overall OU 10-03 ordnance areas' assessment scheduled for 1998. For the TNT- and RDX-contaminated soils, the primary objective of the removal action was to mitigate the potential excess cancer risk associated with personnel inhalation, ingestion, and dermal absorption of soils contaminated with TNT and RDX. The secondary objective was to identify a cost-effective method for treating soil contaminated with explosive residues at the INL Site.

12.1.1.3 1996 Time-Critical Removal Action. As outlined in the *U.S. Department of Energy, Idaho Operations Office Lead Agency Action Memorandum Time-Critical Removal Action Ordnance Areas Operable Unit 10-03 Idaho National Engineering Laboratory (INEL)* (DOE-ID 1996), a time-critical removal action was selected as the alternative to clear four sites (discussed above) of UXO based on a report issued in May 1996 by the Army Corps of Engineers. The memorandum indicated that the time-critical removal action was justified if the ordnance is exposed and directly threatens human lives. The four areas met these criteria. To accomplish the goal of mitigating the threat from the ordnance, the purpose of the time-critical removal action was to locate, clear, and detonate UXO and clear ordnance and explosive waste at the four sites.

12.1.1.4 1997 Non-Time-Critical Removal Action. As outlined in the *Engineering Evaluation Cost Analysis for Nontime-Critical Removal Action for Unexploded Ordnance at the Idaho National Engineering and Environmental Laboratory Operable Unit 10-03* (DOE-ID 1997), a non-time-critical removal action was performed to clear UXO at eight sites at the INL Site: NODA, the rail car explosion

area, the mass detonation area, the NOAA grid, the Experimental Field Station, Fire Station II, the craters east of INTEC, and the land mine fuze burn area. The 1997 removal action addressed 111 acres at NODA, 52 acres at the rail car explosion area, 74 acres at the mass detonation area, 27.3 acres at the NOAA grid, 2 acres at the Experimental Field Station, 2.5 acres at Fire Station II, 5 acres at the land mine fuze burn area, and 10 acres at the craters east of INTEC.

The recommended alternative for the removal action was search and detonation of UXO. This alternative was selected, because it was the only one that fully mitigated the explosive hazard to INL Site workers. It was a proven method of eliminating the explosive hazard of uncontrolled detonation and was a cost-effective remedy that could be implemented in a timely fashion.

12.1.1.5 2004 Time-Critical Removal Action. As outlined in the *U.S. Department of Energy Idaho Operations Office, Lead Agency Action Memorandum Time-Critical Removal Action for Unexploded Ordnance, Operable Unit 10-04, Idaho National Engineering and Environmental Laboratory* (INEEL 2003a), a time-critical removal action was warranted to remove UXO discovered after a range fire burned through an area between CFA and the RTC. In addition, several "live" pieces of UXO were discovered east of INTEC. The removal and destruction of UXO by high-order detonation using additional explosives to initiate the detonation addressed the immediate hazards associated with the UXO, namely inadvertent detonation and injury to personnel.

12.1.1.6 Operable Unit 10-04 Phase I Remedial Action. As outlined in the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a), the Phase I activities for the comprehensive remedial action consisted of developing and implementing institutional controls at OU 10-04 sites and developing and implementing INL Sitewide plans for both institutional control and ecological monitoring. Phase I of the RD/RA for OU 10-04 also provided for the removal or isolation of identified surface UXO and TNT/RDX fragments that pose an unacceptable near-term physical hazard. Removal or isolation activities during Phase I of the OU 10-04 RD/RA will not initiate full remediation of the contaminated areas.

12.1.2 Remedial Action Objectives

The following subsections describe the RAOs for each of the time-critical and non-time-critical removal actions, the interim action, and Phase I of the OU 10-04 remedial action.

12.1.2.1 Operable Unit 10-05 Interim Action. A baseline risk assessment was not completed for OU 10-05 at the time of the interim action ROD but has subsequently been performed under the *Record of Decision – Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2002b). The main risk associated with the six sites addressed under the interim action was the potential explosive hazard associated with the uncontrolled detonation of UXO. To that end, the primary purpose of the interim action was to reduce those risks by finding and disposing of UXO from the six areas identified for the interim action.

Additional risks resulting from exposure to soils contaminated with explosive residues also were addressed during the interim action. Risk-based soil concentrations were back-calculated from the established National Contingency Plan target risk range of 1E-04 to 1E-06 for carcinogenic contaminants and a hazard index of 1 for noncarcinogenic contaminants. Based on those criteria, screening action levels of 440 mg/kg for TNT and 180 mg/kg for RDX were selected to address soils that had concentrations of contaminants exceeding the 1E-04 risk-based soil levels with cleanup standards for the interim action of 44 mg/kg for TNT and 18 mg/kg for RDX, based on the 1E-05 risk-based soil concentrations.

12.1.2.2 1994 Non-Time-Critical Removal Action. As previously stated, the non-time-critical removal action was conducted at three sites for UXO and three separate sites for TNT- and RDX-contaminated soils. The cleanup standards for soils were 44 ppm for TNT and 18 ppm for RDX. The cleanup standards represented the maximum concentration of soil contaminants allowed to remain in place after excavation of the contaminated locations. The standards were based on the results of risk analysis conducted for the OU 10-04 interim remedial action with concentrations of 44 ppm for TNT and 18 ppm for RDX, representing an excess cancer risk of 1E-05 based on an occupational dermal contact exposure scenario. This scenario was selected, because it resulted in the lowest risk-based concentrations for the exposure pathway.

12.1.2.3 1996 Time-Critical Removal Action. The 1996 time-critical removal action was implemented at four areas that had recently been discovered and presented an imminent risk to INL Site personnel and the public. It was concluded from a site report by the Army Corps of Engineers ordnance experts that these areas presented a risk that should be addressed immediately. This was based on the corps listing the sites with a risk assessment code of 1, which indicated an immediate hazard. The risk assessment code of 1 was based on the ordnance being exposed and human lives threatened, justifying the implementation of a time-critical removal action. Therefore, the action was taken to remove the UXO from the four areas in an effort to reduce the risk posed by its presence.

12.1.2.4 1997 Non-Time-Critical Removal Action. The primary objective of the 1997 removal action was to mitigate the explosive hazard of uncontrolled detonation of ordnance to INL Site workers. The secondary objective was to remove the soil contaminated with explosives. Sites identified as exceeding the remediation goals were evaluated and remediated in 1998. The remediation goals for TNT, RDX, and dinitrotoluene were as follows:

- 47 mg/kg for TNT
- 180 mg/kg for RDX
- 35 mg/kg for dinitrotoluene.

12.1.2.5 2004 Time-Critical Removal Action. The primary objective of the 2004 time-critical removal action was to remove exposed UXO from critical areas at the INL Site. The projectiles and fuzes identified in these areas presented an imminent risk to INL Site personnel and the public. As previously discussed in the section pertaining to the 1996 time-critical removal action, the guidance from the Army Corps of Engineers indicated that a time-critical removal action is warranted in situations when there is an immediate threat due to exposure to ordnance with the risk of serious injury or death. The critical areas identified for the 2004 time-critical removal action contained 5-in. anti-aircraft projectiles and fuzes that presented an explosion hazard due to high explosives. In addition to the explosion hazard, the items also presented a security risk of deliberate detonation.

12.1.2.6 Operable Unit 10-04 Phase I Remedial Action. Institutional controls will be maintained for the WAG 10 sites where risk is greater than 1E-04 (1 in 10,000) for a hypothetical current residential scenario. For purposes of evaluating the need for institutional controls at WAG 10, the potential for current residential risk in excess of 1E-04 was inferred from the risk assessment for the 100-year future residential scenario. Any site with an estimated risk of 1E-06 or greater for the 100-year future residential scenario was assumed to pose a current residential risk of 1E-04. Institutional controls will be implemented and maintained until at least 2095 at WAG 10 sites that pose such a risk, based on the *Idaho National Engineering and Environmental Laboratory Comprehensive Facility and Land Use Plan* (DOE-ID 2005b), or until the site is released for unrestricted use based either on successful remediation of the site or agency agreement in a five-year review that the site is released for unrestricted use.

In addition to implementation of institutional controls at WAG 10 sites, the *Record of Decision – Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2002b) mandated development of a comprehensive INL-wide approach for establishing, implementing, enforcing, and monitoring institutional controls in accordance with EPA Region 10 policy (EPA 1999). The ROD also provided that an institutional control status report would be submitted to the agencies within 6 months of the ROD signature and that the report would be updated at least annually thereafter until the first five-year review. The ROD (DOE-ID 2002b) also mandated implementation of an INL-wide, long-term comprehensive approach for ecological monitoring to ensure protection of the ecosystem at the INL Site.

12.1.3 Remedy Implementation

12.1.3.1 Operable Unit 10-05 Interim Action. The results of the OU 10-05 interim action are documented in the *Remedial Action Report for the Interim Action to Cleanup Unexploded Ordnance Locations at the INEL (Operable Unit 10-05)* (Wyle 1994). The specific mission of the interim action was to locate, identify, detonate, and dispose of UXO and associated shrapnel and to characterize, remove, and incinerate soils contaminated with explosive residues at six sites. The six sites addressed under the interim action were the CFA gravel pit, the unexploded storage bunkers north of INTEC, the NOAA grid, the CFA-633 naval firing site, and the Anaconda power line. The specific tasks included the completion of visual and geophysical searches, removal of ordnance and explosive particulate, initial sampling of selected areas, removal of contaminated soil, verification sampling of excavated areas, reclamation of the sites, and shipment of contaminated soil for disposal.

Ordnance was located and either disposed of by detonation or demilitarized, with the scrap metal disposed of at the CFA landfill, and the explosive was disposed of by detonation. Items included an electric squib, illumination candles, grenades, projectiles, fuze components, and miscellaneous UXO. During searches to locate UXO, evidence of soil contamination was found and flagged for sampling. Soil contamination was noted at Fire Station II, the CFA-633 naval firing site, and the NOAA area. Locations identified during the sampling effort that exceeded the action levels of 440 ppm TNT and 180 ppm RDX were excavated and containerized for shipment off-Site for disposal by incineration. In most cases, the sampling results indicated that the contamination was limited to within 4 in. of the surface. An iterative process of excavation followed by verification sampling was implemented to ensure that contamination exceeding the action levels had been removed. A total of 201 1-yd^3 boxes were filled with contaminated soil, most of which originated from the CFA-633 area with smaller amounts coming from the NOAA and Fire Station II areas. The areas impacted by the excavation activities were reseeded.

12.1.3.2 1994 Non-Time-Critical Removal Action. The 1994 action was carried out over 16 months, beginning in 1994 with the cleanup of the Twin Buttes Bombing Range, the four projectiles located east of Lincoln Boulevard at Mile Marker 17, and a portion of the NODA. Cleanup of the remainder of the NODA site was completed during the summer and fall of 1995. The *Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995a) summarizes the work performed in 1994, and the *Addendum to the Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995b) updates the report as to the work completed in 1995. Work-specific tasks included mobilization to the site, a visual UXO search of the site followed by a geophysical search, and ordnance and scrap removal. The located UXO was either destroyed in place or transported to the mass detonation area for disposal by high-order detonation. Demilitarized UXO was inspected to ensure that no hazard remained and was then taken to the CFA landfill for disposal.

The selected remedy for the TNT- and RDX-contaminated soils was bioremediation. A treatability study was completed in 1999, as documented in the *Waste Area Group 10 RDX/TNT CERCLA Treatability Study Final Report* (INEEL 2000). The study demonstrated that the technology

was technically feasible; however, the ROD (DOE-ID 2002b) provides a selected remedy of removal by excavation over bioremediation. The TNT and RDX portion of the 1994 non-time-critical removal action has not been completed but will be addressed under Phase II of the OU 10-04 remedial action scheduled for 2007.

12.1.3.3 1996 Time-Critical Removal Action. The results of the 1996 time-critical removal action are documented in the *Final Action Report for the Time Critical Removal Action, Operable Unit 10-03* (Parsons 1997). The primary tasks included mobilization to the site, visual search for UXO, ordnance and scrap removal, a geophysical search for UXO followed by analysis of geophysical survey data, demilitarization of ordnance items, and disposal of ordnance and explosive items by detonation. Within the land mine fuze burn area, a total of 1,018 individual fuzes were removed, 118 of which contained explosives. Additionally, over 36,000 lb of scrap and approximately 60 lb of raw explosive also were removed from the area. Scrap removed from the rail car explosion area included over 4,250 lb of inert materials, including rail car components and ordnance residue. In addition, several other explosive items, including portions of 18 aerial bombs and 10 5-in. projectiles were collected from various locations and destroyed during demolition operations. All loose explosives encountered during the project were collected and destroyed during the demolition of the UXO.

12.1.3.4 1997 Non-Time-Critical Removal Action. The *Summary Report for the 1997 Non-Time Critical Removal Action for Ordnance at Operable Unit 10-03* (INEEL 1999) presents the results of the 1997 non-time-critical removal action. The areas included were the NODA, the NOAA grid, the Fire Station II zone, the mass detonation area, the Experimental Field Station, the rail car explosion area, the land mine fuze burn area, and the craters east of INTEC. Ordnance removal was completed at four of the eight sites: the NOAA grid, the Fire Station II zone, the Experimental Field Station, and the craters east of INTEC. Further removal of ordnance was required at the remaining four sites after the 1997 non-time-critical removal action was completed. The removal action at these four sites was not completed in 1997 because of programmatic funding constraints. However, the removal action for the NODA grid was completed as part of the 2004 time-critical removal action. Removal actions for the mass detonation area, the rail car explosion area, and the land mine fuze burn area will be addressed under Phase IV of the OU 10-04 remedial action, which is currently planned to begin in 2007.

12.1.3.5 2004 Time-Critical Removal Action. The *Summary Report for the 2004 Time-Critical Removal Action for Unexploded Ordnance at Operable Unit 10-04* (ICP 2004) summarizes the results of the 2004 time-critical removal action. The objective of the time-critical removal action was to remove, transport, and destroy UXO that was found near the NODA and INTEC. The UXO was recovered, transported to the mass detonation area, and destroyed by high-order detonation. In total, 55 5-in. anti-aircraft common rounds and 11 fuzes were recovered and disposed of.

12.1.3.6 Operable Unit 10-04 Phase I Remedial Action. Implementation of the OU 10-04 Phase I remedial action is discussed in the *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005a). The primary purpose of the Phase I remedial action was to establish institutional controls at 28 WAG 10 sites that have been contaminated by various means, including operations and activities associated with the testing of ordnance and explosives. The WAG 10 sites assessed under Phase I of OU 10-04 included the LCCDA; the OMRE leach pond; the sites related to the EOCR (which later became the STF); the STF sumps, pits, and gun range; and numerous ordnance areas.

Implementation of institutional controls included emplacement of institutional control signs at the applicable WAG 10 sites and visible access restrictions to the INL Site. Land use restrictions for the WAG 10 sites require that the DOE-ID notify the EPA and DEQ before any transfer, sale, or lease to a nonfederal entity (such as a state or local government or a private person) of any DOE-ID-managed real property that is the subject to institutional controls required by the ROD (DOE-ID 2002b). Restrictions on

drilling or excavation activities within the institutionally controlled WAG 10 sites require completion of an environmental checklist, with conditions that must be met before beginning a project that might disturb soil within a specified site. The checklist also must identify the applicable instructions that the drilling/excavation project must comply with as well as any ARARs.

The *Operations and Maintenance Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004c) describes the long-term RD/RA activities for Phase I of OU 10-04 at the INL Site. These activities include removal or isolation of surface ordnance and explosives discovered during routine operations that, based on expert evaluation, pose an unacceptable near-term physical hazard. The *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004d) documents the site-specific institutional controls currently in place at the INL Site. The plan identifies common institutional control measures and describes methods used to inspect institutionally controlled sites and methods to evaluate whether the institutional control requirements are being met. The *Long-Term Ecological Monitoring Plan for the Idaho National Engineering and Environmental Laboratory* (INEEL 2004) presents the approach for INL long-term ecological monitoring and two primary objectives. The first is to verify that the objectives of each INL Site remedial action are maintained. The second is to determine that the long-term, INL Sitewide ecological impact of the contamination left in place is within acceptable limits. In accordance with that plan, an annual FSP will be prepared to describe the field investigations to be performed within a fiscal year. Once the monitoring is completed for a particular year, an annual report that summarizes the results of the monitoring effort will be prepared.

12.2 Data Evaluation

12.2.1 Site Inspections

Institutional control inspections are conducted annually at WAG 10 sites. The following summaries discuss annual inspections sites conducted at WAG 10 within the timeframe of this five-year review.

Institutional control inspections were required within 6 moths of signature of the ROD and were completed in March 2003 (INEEL 2003b). No deficiencies were identified during the 2003 inspection; however, the sites were posted with “Environmentally Controlled Area” signs, which needed to be replaced with the standardized institutional control sign. Signs were replaced during inspections conducted in June 2004 (DOE-ID 2004e). Visible access restrictions, control of activities, and land-use restrictions were evaluated, and no deficiencies were identified.

Operations and maintenance at WAG 10 consist of removal or isolation of surface ordnance and explosives discovered during routine operations. Consequently, dedicated operations and maintenance inspections are not conducted at WAG 10.

12.2.2 Time-Critical Removal Actions

For the 1996 time-critical removal action and the 2004 time-critical removal action, actions were implemented to reduce the risk to personnel and the public due to the presence of UXO. No remediation of contaminated soils was performed; therefore, no data were collected. The selected remedy for the 1994 non-time-critical removal action for TNT- and RDX-contaminated soils was bioremediation. As discussed previously, the TNT and RDX portion of the 1994 non-time-critical removal action was not completed; therefore, no data evaluation is required. For the OU 10-04 comprehensive ROD, the remedial actions have yet to be performed. Data evaluation is limited to the OU 10-05 interim action.

12.2.2.1 Operable Unit 10-05 Interim Action. As stated previously, sampling during the OU 10-05 interim action was performed at Fire Station II, the CFA-633 naval firing site, and the NOAA area. The cleanup standards for the interim action were 44 mg/kg for TNT and 18 mg/kg for RDX. For the CFA-633 area, the TNT verification sample results ranged from below the method detection limit to a maximum of 6.4 mg/kg, with a single result outside of the normal range of 228 mg/kg. The RDX results ranged from below the method detection limit to a maximum of 24 mg/kg. The maximum results were below the defined action levels for the interim action.

The NOAA area TNT verification sample results ranged from below the method detection limit to a maximum of 6.7 mg/kg. All RDX verification sample results were below the method detection limit. For the Fire Station II area, the TNT verification sample results ranged from below the method detection limit to a maximum of 29 mg/kg, while the RDX verification sample results ranged from below the method detection limit to a maximum of 1.1 mg/kg.

12.2.2.2 1997 Non-Time-Critical Removal Action. For the 1997 non-time-critical removal action, sampling was not completed at seven of the eight sights, because either the ordnance removal was not complete or insufficient time remained in the 1997 field season. Soil sampling for these seven sites was deferred to the OU 10-04 RI/FS. Sampling was completed during the 1997 non-time-critical removal action at the mass detonation area. The remediation goals for TNT, RDX, and dinitrotoluene were defined as 47 mg/kg, 180 mg/kg, and 35 mg/kg, respectively. The RDX results were below the method detection limit. The dinitrotoluene results ranged from below the method detection limit to a maximum of 1.6 mg/kg. The TNT results ranged from below the method detection limit to a maximum of 94 mg/kg.

12.3 Progress since Last Review

This is the first five-year review conducted for WAG 10. However, ongoing remediation activities include the maintenance of institutional controls at the WAG 10 sites and continued operations and maintenance activities and ecological monitoring, as defined for the OU 10-04 Phase I remedial action. Future activities include implementation of OU 10-04 Phases II through IV and preparation of the OU 10-08 RI/FS and subsequent ROD.

12.3.1 Operable Unit 10-04 Phase I Activities

As discussed previously, the OU 10-04 Phase I remedial action consists of the following four main activities:

- Implementation and maintenance of institutional controls at WAG 10 sites
- Operations and maintenance activities, specifically to include the removal and disposal of ordnance and explosives that pose an imminent hazard to human health
- Preparation and implementation of an INL Sitewide institutional controls plan
- Preparation and implementation of an INL Sitewide long-term ecological monitoring plan.

The 28 WAG 10 sites requiring institutional controls are as follows:

- OMRE-01: OMRE leach pond
- ORD-01: Arco High-Altitude Bombing Range
- ORD-03: CFA-633 naval firing site and downrange area
- ORD-04: CFA gravel pit
- ORD-05: CFA sanitary landfill area
- ORD-06: NODA
- ORD-07: Explosive storage bunkers—north of INTEC
- ORD-08: NOAA area
- ORD-09: Twin Buttes Bombing Range
- ORD-10: Fire Station II zone and range fire burn area
- ORD-11: Anaconda power line
- ORD-12: old military structures
- ORD-13: mass detonation area
- ORD-14: dairy farm revetments
- ORD-15: Experimental Field Station
- ORD-16: UXO east of the RTC (formerly the TRA)
- ORD-17: burn ring south of the Experimental Field Station
- ORD-18: igloo-type structures northwest of the Experimental Field Station
- ORD-19: rail car explosion area
- ORD-20: UXO east of the Army Reentry Vehicle Facility site
- ORD-21: Juniper Mine
- ORD-22: projectiles found near Mile Markers 17, 18, and 19
- ORD-24: land mine fuze burn area
- ORD-25: ordnance and dry explosives east of the Big Lost River (same as ORD-19)
- ORD-26: zone east of the Big Lost River
- ORD-27: dirt mounts near the Experimental Field Station, NOAA, and NRF
- ORD-28: craters east of INTEC
- STF-02: STF gun range.

Institutional controls will remain in place at these 28 sites until the remediation is either successfully completed or the controls are discontinued based on the results of a five-year review.

12.3.2 Operable Unit 10-04 Phase II Activities

The requirements for the OU 10-04 Phase II activities are delineated in the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase II* (DOE-ID 2004b). Specifically, Phase II addresses the removal and destruction of TNT and RDX fragments found on five sites and remediation of chemically contaminated (principally TNT and RDX) soil found at the explosive test sites. The following five sites are located within the Naval Proving Ground:

- Fire Station II zone and range fire burn area
- Experimental Field Station
- Land mine fuze burn area
- NOAA area
- NODA.

The remediation of the TNT/RDX-contaminated soil sites will include (1) establishing and maintaining institutional controls during Phase I (as required) until the contamination is removed or reduced to acceptable levels, (2) performing a visual survey to identify any UXO and TNT/RDX fragments and stained soil coupled with a geophysical survey for UXO, (3) excavating contaminated soil, (4) segregating and disposing of TNT/RDX fragments at the mass detonation area, (5) sampling and analyzing soil to determine excavation requirements and when the remediation goals have been achieved, (6) backfilling and contouring excavated areas, (7) revegetating affected areas, and (8) monitoring air and soil during the remedial action.

The current working schedule for the Phase II activities provides that the remedial action field work will commence in October 2007 with a projected completion date of August 2008. The draft Phase II remedial action report will be submitted to the agencies in November 2008 with an enforceable date of November 30, 2015.

12.3.3 Operable Unit 10-04 Phase III Activities

The "Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase III (Draft)"[a] outlines the requirements for the OU 10-04 Phase III activities that address the remediation of lead-contaminated soil at the STF-02 gun range. Remediation of the gun range will include (1) excavation of contaminated soil, (2) physical separation of copper and lead for recycling (if allowed by DOE policy), (3) returning to the site any separated soils that are below the remediation goal, (4) stabilization of contaminated soils as required, (5) disposal of the separated soils that exceed the remediation goal, (6) encapsulation of creosote-contaminated railroad ties and disposal, (7) removal and disposal of the wooden building and asphalt pads found at the gun range, (8) sampling and analysis of soil to determine excavation requirements and when the remediation goals have been met, (9) backfilling and contouring excavated areas, and (10) revegetating the affected area.

The current working schedule for the Phase III activities provides that the remedial action fieldwork will commence in October 2009 with completion slated for October 2010. The draft Phase III remedial action report will be submitted to the agencies in March 2011 with an enforceable date of August 31, 2018.

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a. "Remedial Design/Remedial Action Work Plan for Operable Unit 6-05 and 10-04, Phase III (Draft)," DOE/NE-ID-11202, Rev. 0, U.S. Department of Energy Idaho Operations Office, March 2005.

12.3.4 Operable Unit 10-04 Phase IV Activities

The OU 10-04 Phase IV activities address the remediation of UXO-contaminated sites. The RD/RA work plan for Phase IV will be prepared in FY 2006. The three main sites requiring remediation for UXO include the Naval Proving Ground, the Arco High-Altitude Bombing Range, and the Twin Buttes Bombing Range. The Naval Proving Ground includes 29 smaller ordnance sites; six of the sites have a high probability for and/or the confirmed presence of UXO. These six smaller sites include the Experimental Field Station, the NOAA area, the land mine fuze burn area, the mass detonation area, the rail car explosion area, and NODA. Because the mass detonation area will be used for the disposal of UXO and explosives by detonation, the area will be further assessed for the presence of explosives during the Phase IV activities and remediated for explosives in addition to UXO, as necessary.

As defined in the *Operable Units 6-05 and 10-04, Experimental Breeder Reactor I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2003a), the draft RD/RA work plan will be prepared in FY 2006 with an enforceable date of submittal to the agencies for review by July 31, 2006. The remedial action fieldwork will commence with the mobilization for UXO surveys in February 2011 followed by UXO removal and disposal by detonation. The working schedule date for the Phase IV remedial action report provides for submittal of the draft for review by the agencies in November 2013 with an enforceable date of September 2020. The working schedule date for the remedial action report might be accelerated based on the new contract for INL Site cleanup; the fieldwork schedule might be moved forward as well.

12.3.5 Operable Unit 10-08 New Sites, Track 1s, and Track 2s

In accordance with the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Group 6 and 10, Operable Unit 10-04* (DOE-ID 2001), the OU 10-04 responsibilities discussed in the FFA/CO (DOE-ID 1991) have been modified by the inclusion of OU 10-08. The OU 10-08 RI/FS scope includes the evaluation of the INL Sitewide groundwater concerns, the evaluation of new sites that are passed to WAG 10 by other WAGs, and the evaluation of new sites that are discovered after the OU 10-04 RI/FS process is completed. OU 10-08 may also be responsible for characterizing and performing necessary remedial activities at new sites discovered inside the boundaries of WAGs 1 through 7.

To date, a total of 76 new sites have been included for evaluation under OU 10-08. These sites include three from CFA, three from PBF, 15 from the RTC, nine from TAN, and 48 miscellaneous sites outside of the other WAGs. Table 12-3 summarizes the OU 10-08 sites and the current determination for each of them.

12.3.6 Operable Unit 10-08 Snake River Plain Aquifer

One of the primary purposes of OU 10-08 is the comprehensive evaluation of impacts to groundwater from operations at the INL Site. Some of these operations have introduced radioactive and hazardous contaminants into the environment, and a number of these contaminants have been found in the SRPA. The potential impacts to the groundwater from INL Site activities are being thoroughly investigated as part of the OU 10-08 RI/FS.

Table 12-3. Operable Unit 10-08 new sites.

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
1	TAN-30	TAN/TSF Fire Station wastewater system discharge drainage ditch	NSI	No action	01/31/2005
1	TSF-08	TSF Heat Transfer Reactor Experiment III mercury spill area	ESD	Risk reevaluation under OU 10-08 RI/FS	Pending
1	TSF-49	1-TAN IDWR #1 TAN-702	NSI	No action	Pending
1	TSF-50	2-TAN IDWR#2 TAN-724	NSI	No action	Pending
1	TSF-51	TAN-607A pool release	NSI in preparation	—	—
1	TSF-52	TAN-607 Decontamination Shop waste discharge pipe	NSI	Evaluate under the OU 10-08 RI/FS.	Pending
1	TSF-53	Saturated soil on the west side of TAN-633	NSI in preparation	—	—
1	TSF-54	Soil beneath TAN-607 Decontamination Shop sump	NSI	Evaluate under the OU 10-08 RI/FS.	Pending
1	TSF-55	Soil in pipe trench west of TAN-666	NSI	Evaluate under the OU 10-08 RI/FS.	Pending
2	TRA-56	TRA acid transfer line from TRA-631 to TRA-645	Track 1	To be evaluated under OU 10-08 comprehensive RI/FS; maintain institutional controls	02/26/2003
2	TRA-57	Abandoned buried diesel fuel oil line	Track 1	To be evaluated under OU 10-08 comprehensive RI/FS	05/09/2002
2	TRA-59	Abandoned buried acid line from TRA-631 to TRA-671	Track 1	No further action	02/26/2003
2	TRA-60	Fenced area north of TRA-608	Track 2	No further action	Pending
2	TRA-62	Abandoned discharge lines, TRA-608 area to TRA-701 chemical leach pond	Track 2 investigation ongoing	—	—
2	TRA-63	TRA-605 warm waste line	Track 2	No further action	Pending
2	TRA-64	5-TRA IDWR #12 TRA FD5	NSI	No action	Pending
2	TRA-65	7-TRA IDWR#15 TRA FD7	NSI	No action	Pending
2	TRA-66	8-TRA IDWR#16 TRA FD8	NSI	No action	Pending

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
2	TRA-67	13-TRA IDWR#21 TRA FD13	NSI	No action	Pending
2	TRA-68	14-TRA IDWR#22 TRA FD14	NSI	No action	Pending
2	TRA-69	15-TRA IDWR#23 TRA FD15	NSI	No action	Pending
2	TRA-70	19-TRA IDWR#27 TRA FD19	NSI	No action	Pending
2	TRA-71	20-TRA IDWR#None TRA FD20	NSI	No action	Pending
2	TRA-72	21-TRA IDWR#None TRA FD21	NSI	No action	Pending
4	CFA-10A	Soil-filled concrete ring adjacent to CFA-667	Track 2	No action	Pending
4	CFA-53	Soil beneath CFA-617 wastewater piping and drains	NSI	No further action	Pending
4	CFA-54	Buried waste pipe south of CFA-674	Track 2	Investigation ongoing	Pending
5	PBF-33	Abandoned debris trench	Track 1	No action; remove asbestos-containing debris.	Pending
5	PBF-34	Abandoned debris located near the Mixed Waste Storage Facility	Track 1l	No action	Pending
5	PBF-35	Abandoned power and control cables between buildings at the PBF Complex	Track 1	No action	01/14/2005
10	MISC-01	Debris along the Big Lost River near the RWMC	Track 1	No further action	03/29/2002
10	MISC-02	Car body south of Highway 33 on the INL Boundary Road	Track 1	No further action	08/25/2004
10	MISC-03	Car body adjacent to the Big Lost River	Track 1	No further action	04/02/2002
10	MISC-04	Diesel-saturated dirt pile near Experimental Field Station	Track 1	Characterize for hydrocarbons	01/14/2005
10	MISC-05	Excavation pit/mound and debris east of Guard Gate 3	Track 1	No further action	Pending
10	MISC-06	Cistern north of NRF	Track 1	No further action	04/02/2002
10	MISC-07	Debris near cinder pit on the INL southern border	Track 1	No further action	04/02/2002

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
10	MISC-08	Debris near intersection of Highways 33 and 22	Track 1	No further action	Pending
10	MISC-09	Debris south of Highway 33 east of TAN	Track 1	No action	09/03/2004
10	MISC-10	Debris in canal west of Guard Gate 3	Track 1	No action	01/14/2005
10	MISC-11	Debris west of the southern end of Highway 22	Track 1	No further action	04/02/2002
10	MISC-12	Debris north of Highway 33 near the west entrance	Track 1	No further action	04/02/2002
10	MISC-13	Debris next to canal inside boundary of NRF	Track 1	No further action	04/02/2002
10	MISC-14	Debris in the Big Lost River sinks area	Track 1	No further action	04/02/2002
10	MISC-15	Navy debris in canal between the RTC and the NRF	Track 1	No further action	Pending
10	MISC-16	Farming debris in Big Lost River sinks area	Track 1	No further action	09/03/2004
10	MISC-17	Staining on East Butte Road	Track 1	No action	01/14/2005
10	MISC-18	Uncapped well in Big Lost River sinks area	Track 1	No action; abandon in accordance with Idaho Administrative Procedures Act standards.	01/14/2005
10	MISC-19	Homestead site at Birch Creek and Cedar Canyon Road	Track 1	No further action	04/02/2002
10	MISC-20	Stained road near NRF	Track 1	No further action	04/02/2002
10	MISC-21	Staining on Road 17 from STF to Portland Road	Track 1	No action	01/14/2005
10	MISC-22	Rusty metal debris adjacent to Highway 28	Track 1	No action	09/03/2004
10	MISC-23	Debris in Birch Creek drainage gravel pit	Track 1	No further action	04/02/2002
10	MISC-24	Homestead site northwest of the Specific Manufacturing Capability	Track 1	No further action	04/02/2002

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
10	MISC-25	Mounds, cans, and drums northeast of NRF	Track 1	Perform total petroleum hydrocarbon analyses to determine the need for a Track 2.	Pending
10	MISC-26	Detonation pit between NRF and TRA	Track 1	ESD to OU 10-04 ROD for inclusion	01/14/2005
10	MISC-27	Mound near East Portland/East Ogden intersection	Track 1	No action	01/14/2005
10	MISC-28	Canal builder's campsite	Track 1	No action	01/14/2005
10	MISC-29	Asphalt near main guard gate	Track 1	No further action	09/03/2004
10	MISC-30	Debris on Richard Butte	Track 1	Remove batteries and analyze soil for zinc; if noncompliant, include in OU 10-08; if compliant, no action	01/14/2005
10	MISC-31	Two 8-in.-diameter rounds	Track 1	No action	01/14/2005
10	MISC-32	Mound near RWMC gravel pit	Track 1	No action	01/14/2005
10	MISC-33	Experimental test drum in EOCR-01 leach pond	Track 2	No action	Pending
10	MISC-34	Howe Peak diesel spill	Track 1	No action	01/14/2005
10	MISC-35	Detonation pits north of EOCR	Track 1	ESD to OU 10-04 ROD for inclusion	01/14/2005
10	MISC-36	Debris southwest of Highway 28	Track 1	No action	09/03/2004
10	MISC-37	Lids by Experimental Field Station	Track 1	No action	01/14/2005
10	MISC-38	Uncapped well east of the MFC	Track 1	No action; abandon in accordance with Idaho Administrative Procedures Act regulations.	01/14/2005
10	MISC-39	Ammunition remains in EOCR area	Track 1	No action	01/14/2005
10	MISC-40	Mound southeast of EOCR buildings	Track 1	No action	01/14/2005
10	MISC-41	Pits/mounds northeast of EOCR	Track 1	No action	01/14/2005
10	MISC-42	Construction debris northeast of EOCR	Track 1	No action	01/14/2005
10	MISC-43	Construction pit northwest of EOCR	Track 1	No action	01/14/2005
10	MISC-44	Concrete-lined depression west of CFA	Track 1	No action	01/14/2005

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
10	MISC-45	Dirt pile with naval smoke cans near INTEC	Track 1	Track 2	01/14/2005
			Track 2 investigation ongoing	—	—
10	MISC-46	Test apparatus west of CFA	Track 1	No further action; remove the trash.	09/03/2004
10	MISC-47	Small fuel tank north of INTEC	Track 1	No action; remove the tank.	01/14/2005
10	MISC-48	Mud Lake landfill	NSI	No action	Pending

a. Documents identified as pending require agency approval/signoff by one or more of the agencies.

CFA = Central Facilities Area
EOCR = Experimental Organic-Cooled Reactor
ESD = explanation of significant differences
FD = field drain
IDWR = Idaho Department of Water Resources
INL = Idaho National Laboratory
INTEC = Idaho Nuclear Technology and Engineering Center
MFC = Materials and Fuels Complex
NRF = Naval Reactors Facility
NSI = new site identification
OU = operable unit
PBF = Power Burst Facility
RI/FS = remedial investigation/feasibility study
ROD = Record of Decision
RTC = Reactor Technology Complex
RWMC = Radioactive Waste Management Complex
STF = Security Training Facility
TAN = Test Area North
TRA = Test Reactor Area
TSF = Technical Support Facility
WAG = waste area group

The comprehensive nature and scope of OU 10-08 necessitate that monitoring data be collected over many years and long-term integration be maintained among individual WAGs to ensure that all data needed are available for the OU 10-08 RI/FS. The large area of the OU 10-08 domain and the long groundwater travel times require long-term monitoring of water quality and water levels to adequately characterize the SRPA for risk-assessment calculations. In addition, it is critical that the OU 10-08 numerical and conceptual model be interfaced with the other individual WAG models to create a comprehensive understanding of the aquifer flow regime, contaminant sources, and contaminant transport in the SRPA. An integrated understanding of the overall health of the SRPA beneath the INL Site is critical for communicating INL impacts to others who use SRPA water.

The work scope of the OU 10-08 RI/FS is based on filling data gaps originally identified in the OU 10-08 RI/FS Work Plan (DOE-ID 2002a). The activities in the work scope are necessary to characterize and assess INL-wide groundwater risks and will ultimately be used in the OU 10-08 ROD. It is important to note that many of the tasks done under the OU 10-08 RI/FS also support individual WAGs. For example, the groundwater flow characteristics and INL-scale subsurface stratigraphy are used as boundary conditions for the smaller "windows" in the SRPA studied by individual WAGs. In addition, assessment of intermingling plumes between INTEC and RWMC will impact risk assessment calculations. The tasks identified in the OU 10-08 RI/FS Work Plan and the progress made toward their completion are summarized in reports published annually. To date, the *Waste Area Group 10, Operable Unit 10-08, Remedial Investigation/Feasibility Study Annual Report for Fiscal Year 2003* (DOE-ID 2004f) and the *Waste Area Group 10, Operable Unit 10-08, Remedial Investigation/Feasibility Study Annual Status Report for Fiscal Year 2004* (DOE-ID 2005c) have been submitted to the agencies for their review.

The 11 main tasks required to be completed for the OU 10-08 RI/FS are as follows:

1. Develop a comprehensive database of groundwater sample results
2. Evaluate the groundwater
3. Evaluate the alternative groundwater sampling and purging methodology
4. Evaluate the potentially commingled plumes
5. Evaluate the groundwater quality for current compliance with MCLs or other risk-based concentrations
6. Develop a method to incorporate new sites into OU 10-08
7. Evaluate phytoremediation of mercury in soil at the TSF-08 site
8. Revise the Sitewide groundwater model
9. Implement institutional controls
10. Evaluate the risk to groundwater
11. Verify water-level measuring points.

To date, Tasks 1, 3, 6, 9, and 11 have been completed. For Task 1, all sampling data are now entered into the Environmental Data Warehouse, which was developed under the purview of the Long-Term Stewardship Project. The evaluation of alternative groundwater sampling and purging methodology that comprise Task 3 was completed in FY 2003 with a report of the study provided in Appendix C of the *Waste Area Group 10, Operable Unit 10-08, Remedial Investigation/Feasibility Study Annual Report for Fiscal Year 2003* (DOE-ID 2004f). Task 6 has been satisfied with the completion and implementation of Management Control Procedure (MCP) -3448, "Inclusion of New Sites under the Federal Facility Agreement and Consent Order," which details the procedures for reporting new sites and provides direction for listing them with the appropriate WAG. Implementation of institutional controls, as required by Task 9, has been accomplished through the development of the *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004d), which was completed as part of the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a) in FY 2004. Task 11, consisting of the verification of water-level measuring points, was completed in FY 2004 and was documented in the *Long-Term Stewardship Fiscal Year 2004 Well Surveillance/Maintenance Report* (ICP 2005).

With the exception of Task 7 (the evaluation of phytoremediation of mercury in the soil at the TSF-08 site), the remaining tasks revolve around evaluating the groundwater defined by the SRPA and preparing updated conceptual and numerical groundwater models for OU 10-08. The *Idaho National Engineering and Environmental Laboratory Operable Unit 10-08 Sitewide Groundwater Model Work Plan* (DOE-ID 2004g) outlines the work elements associated with modeling efforts required to support OU 10-08. These models will support a comprehensive evaluation and cumulative risk analysis of environmental impacts from INL Site operations to the underlying SRPA for the OU 10-08 RI/FS. Additionally, the model will serve to integrate knowledge gained during investigations of individual WAGs into a comprehensive aquifer management tool for long-term stewardship responsibilities. The efforts will consist of revising and documenting the subregional conceptual model of groundwater flow at the INL Site based on current knowledge, identification of data gaps and the recommended approach for filling those gaps, preparation of an OU 10-08 numerical model of subregional groundwater flow based on the updated conceptual model, and development of a numerical model of contaminant transport to support a comprehensive INL Site groundwater risk assessment.

For Task 7 (the residual risk associated with the mercury contamination remaining at the TSF-08 site), a removal action was performed in 1994, and the area was backfilled with clean gravel. Post-removal sampling showed low levels of mercury at least 2.5 ft below ground surface. The site was transferred to WAG 10, based on agency agreement that the site should be included under the OU 10-08 RI/FS and future ROD. The *Explanation of Significant Differences for the Record of Decision for the Test Area North Operable Unit 1-10* (DOE-ID 2003b) outlines this change. A reevaluation of the final remediation goal for mercury is now warranted for human and ecological receptors, because new guidance and information from the EPA are available. The risk to human health and the environment will be evaluated in FY 2005 under OU 10-08.

12.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

According to sampling data and site inspections, all COCs are at or below action levels as defined for the actions that have taken place to date. It is important to recognize that key remedial actions have yet to be performed, as defined in the ROD (DOE-ID 2002b). At sites where contaminant concentrations prohibit free release of the site or remedial actions have yet to be implemented, institutional controls have been established in accordance with Phase I of the OU 10-04 remedial action.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?*

For interim actions with certain exposure assumptions or toxicological parameters that were used to derive the specified cleanup levels, changes in the parameters have occurred that would negatively impact the original assumptions. With the subsequent development of the ROD (DOE-ID 2002b), the new exposure assumptions and toxicological parameters were used to assess all of the OU 10-04 contaminated soil sites. Based on these revised parameters, updated remediation goals have been developed for the OU 10-04 sites where contamination that poses an unacceptable risk to human health or the environment exists. Those sites will subsequently be remediated for TNT, RDX, or 1,2-dinitrobenzene contamination, as applicable, during Phase II of the OU 10-04 remedial action scheduled to begin in October 2007.

Question C: *Has any other information come to light that would call into question the protectiveness of the remedy?*

As previously stated, the ROD (DOE-ID 2002b) addresses sites requiring remediation based on current exposure and toxicological data. Once implemented, the remedy will be protective of human health and the environment.

12.5 Issues

There are no issues regarding the remedial actions that have been completed at WAG 10.

12.6 Recommendations and Follow-up Actions

No additional recommendations need to be provided at this time, given that the remedial actions involving the TNT/RDX-contaminated soil sites, the lead-contaminated soil at the STF-02 gun range, and the UXO sites are yet to be implemented and the OU 10-08 comprehensive ROD is yet to be written.

12.7 Protectiveness Statement

Institutional controls have been implemented at WAG 10 sites where contamination currently exists and might pose an unacceptable risk to human health or the environment. The use of institutional controls will preclude the inadvertent exposure of personnel and the public until such time as the remedial action is implemented. Overall protectiveness of the defined remedy will be evaluated upon completion.

12.8 Section 12 References

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13. SUMMARY AND CONCLUSIONS

Based on the review of remedial actions at the INL Site, completed remedies are functioning as intended in the decision documents. Remedial actions have been completed at WAGs 2, 4, 5, and 9 and are nearing completion at OU 1-10. The evidence presented in the upcoming remedial action reports is expected to indicate that the selected remedies have achieved the remedial action objectives.

Past remedial actions at the INL Site used risk-based concentrations provided by the Fromm (1996) memorandum. Those remedial actions should be considered effective, because Cs-137 is the primary radionuclide of concern and the remediation activities used a lower (more conservative value) than would be required under the new guidance issued by the EPA. By cleaning to the more protective level, it is assumed that any other radionuclides that would have been present are also now at acceptable levels.

Changes in the slope factor and guidance on the calculation of radionuclide PRGs presented on the EPA website (http://epa-prgs.ornl.gov/radionuclides/) should be considered in all future assessments and cleanup at the INL Site. This includes the new slope factors as well as changes to the calculations of any PRGs, including the use of a gamma shielding factor. The DOE-ID will discuss this issue with the agencies to determine how to best address the use of shielding in calculating risks at the site.

The use of institutional controls prevents uncontrolled exposures until the remedial actions that are not yet in place are implemented. Thus, these actions are protective of human health and the environment. When the remedial actions are completed, the remedies are expected to function as intended in accordance with the decision documents and the protection of human health and the environment will continue.

Because the mission for the MFC (WAG 9) has been changed, the sewage lagoons there are expected to be used until approximately 2030. Therefore, they have been administratively transferred to WAG 10 to allow for closure of WAG 9.

Remedies for the no-further-action or institutionally controlled sites appear to be effective at limiting unauthorized access and excavation. Based on results from the annual assessments of institutionally controlled sites, the controls are in place and the Sitewide approach to institutional controls has streamlined the assessment process.

13.1 Section 13 References

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14. NEXT REVIEW

The next sitewide five-year review at the INL Site will be conducted within 5 years of this report being issued.

Appendix A

Evaluation of Slope Factors and Risk-Based Concentration Changes

Appendix A

Evaluation of Slope Factors and Risk-Based Concentration Changes

A-1. INTRODUCTION

Based on U.S. Environmental Protection Agency (EPA) five-year review guidance, toxicity values (slope factors and reference doses [RfDs]) and associated risk-based concentrations (RBCs) used in the risk assessments should be reviewed for changes. This appendix compared the slope factors, RfDs, and RBCs (also called preliminary remediation goals [PRGs] by the EPA) used in the waste area group (WAG) risk assessments to the newest values available from the Integrated Risk Information System (IRIS) (http://www.epa.gov/iris/), Health Effects Assessment Summary Tables (HEAST), or other approved sources. Slope factors for several nonradionuclides have changed or have been developed since 1997. The changes were minimal and should not impact the remediation decisions. The changes to the radionuclide slope factor and new guidance for calculating RBCs for radionuclides are more significant. Recommendations for addressing those changes are included in this appendix.

A-2. RADIONUCLIDES

The EPA classifies all radionuclides as Group A carcinogens. The EPA provides a radionuclide table (http://www.epa.gov/radiation/heast/) that lists ingestion, inhalation, and external exposure cancer slope factors (risk coefficients for total cancer morbidity) for radionuclides in conventional units of picocuries (pCi). Ingestion and inhalation slope factors are central estimates in a linear model of the age-averaged, lifetime-attributable radiation cancer incidence (fatal and nonfatal cancer) risk per unit of activity inhaled or ingested, expressed as risk/pCi. External exposure slope factors are central estimates of lifetime attributable radiation cancer-incidence risk for each year of exposure to external radiation from photon-emitting radionuclides distributed uniformly in a thick layer of soil and are expressed as risk/yr per pCi/gram soil. These slope factors, when combined with site-specific media concentration data and appropriate exposure assumptions, are used to estimate lifetime cancer risks at the Idaho National Laboratory (INL) Site as a result of radionuclide exposures.

The slope factors also are used to calculate RBCs/PRGs for use in screening and developing cleanup goals. The PRGs and the methodology used to develop them are presented at http://epa-prgs.ornl.gov/radionuclides/. Both the slope factors and RBCs that were used in the initial risk assessments performed for the WAGs undergoing a five-year review have changed because of new EPA guidance. The changes are discussed in the following subsections.

A-2.1 Radionuclide Slope Factors

Radionuclide slope factors used in the assessments for the comprehensive remedial investigations and feasibility studies performed before the middle of 2001 for the WAGs in this five-year review were taken from HEAST (EPA 1995). On April 16, 2001, HEAST was updated to incorporate all new values, based on Federal Guidance Report No. 13, which was developed by the EPA's Office of Radiation and Indoor Air (Eckerman and Ryman 1993). The update incorporates state-of-the-art models and methods that take into account age and gender dependence for radionuclide intake, metabolism, dosimetry, radiogenic cancer risk, and competing risks. Major differences between the risk coefficients of Federal Guidance Report No. 13 (as incorporated into the current radionuclide slope factors) and the

preceding generation of radionuclide slope factors (published in the November 1995 HEAST) include the following:

- Consideration of revised dosimetric models, including a revised lung model, age-dependent biokinetic models, gastrointestinal absorption factors for internal dose estimates, and revised external dose coefficients for external dose estimates

- Consideration of age- and gender-dependent inhalation and ingestion rates

- Incorporation of updated vital statistics and baseline cancer mortality data

- Specification of separate values for ingestion of water, food products, and soil, based on the different age-dependent intake rate functions for such materials instead of the single ingestion value for each radionuclide presented previously.

The age- and gender-specific radiogenic cancer risk models for each of the 14 potential cancer sites used to compute the risk coefficients in Federal Guidance Report No. 13 are similar to those used for previous radionuclide slope-factor calculations, based on the EPA report *Estimating Radiogenic Cancer Risks* (EPA 1994). However, the risk models have been updated to incorporate more recent baseline cancer mortality data and other minor adjustments. The estimate of total radiogenic cancer risk attributable to uniform total-body exposure from low doses of low-linear energy transfer radiation has increased by approximately 11 to 13% from the previous estimates, primarily because of changes in the baseline cancer mortality rates for the U.S. population.

Table A-1 presents a comparison of the 1995 slope factors to the 2001 values. The list of radionuclides includes those from the WAGs in this five-year review and those in the Fromm (1996) risk-based concentration tables. Some important differences are apparent. First, slope factors are now available for ingestion of water, food products, and soil. Previously, only one general slope factor for ingestion was available from HEAST (EPA 1995). Conservatively, the lowest of either the food or the soil ingestion value from the 2001 values was compared to the 1995 ingestion values. Based on Federal Guidance Report No. 13 (Eckerman and Ryman 1993), beta emitters now include external dose. This produced major changes to the Sr-90 and C-14 slope factors, because they now have a slope factor for external exposure.

A larger slope factor equates to a greater possible risk to the receptor. As can be seen from the radionuclides included in this list, over 50% have a greater slope factor; therefore, risk assessments performed using these values may not be conservative. As noted, however, most of these values are less than 10 times greater for most radionuclides with the exception of the external slope factors. The external slope factors have changed significantly. That is, both Sr-90 and C-14 have an external slope factor, and the slope factor for Tc-99 is more than 100 times greater than it was in 1995.

A-2.2 Radionuclide Preliminary Remediation Goals

Since 1996, INL Site personnel have screened radionuclides and used the RBCs for cleanup goals provided by the Fromm (1996) memorandum. It developed radionuclide RBCs for 43 radionuclides using the HEAST 1995 slope factors and the assumptions about shielding at that time. The exposure scenarios from Fromm (1996) address 25-year worker and 30-year residential exposure durations. The risk-based concentrations are based on a current exposure scenario or on a scenario occurring either 30 or 100 years in the future. In the 100-year future scenario, a worker would be exposed from 100 to 125 years from the present, while a residential receptor would be exposed from 100 to 130 years from the present. The

equations used were adapted from those in DOE-ID (1994), which in turn were adapted from the *Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual* (EPA 1991).

Based on the 2001 guidance and slope factors, the EPA has developed PRGs for the current worker (outdoor and indoor), residential soil, agricultural soil, residential soil, tap water, fish ingestion, and groundwater protection. The approach used by the EPA to calculate PRGs includes the use of a gamma-shielding factor that provides for a more realistic assessment of exposure.

Table A-2 presents a comparison of the new EPA PRGs to the RBCs presented in Fromm (1996). To provide the comparison, current resident values were decayed to 2095, as described in Fromm (1996). This provided a future residential PRG similar to that used at the INL Site for the 100-year residential scenario. In addition, the outdoor worker soil PRGs were compared to the current worker PRGs from Fromm (1996).

The EPA changes have both increased and decreased the associated slope factors and PRGs from those used in the past for cleanup at the INL Site. Because of the improved guidance, the new EPA slope factors and PRGs should provide a more accurate evaluation of risk. However, the changes were not immediately addressed, because the primary driver for cleanup at most INL sites is Cs-137. Based on new EPA PRGs, the cleanup goal for Cs-137 would be 40 pCi/g, whereas it is currently 23 pCi/g.

A-2.3 Discussion

As shown in Table A-1, although many of the slope factors have increased, a corresponding increase in the EPA PRGs is not evident, as shown in Table A-2. This is due to the fact that the new guidance for development of PRGs allows for the inclusion of several factors that reduce the exposure in the calculations—primarily, a gamma-shielding factor (GSF) and an area correction factor (ACF). These factors were not included in the development of Fromm's (1996) RBC and generally reduce the amount of exposure and result in a higher PRG.

The GSF is the ratio of the external gamma radiation level indoors onsite to the radiation level outdoors onsite. The GSF is based on the fact that a building provides shielding against penetration of gamma radiation. Therefore, the calculation of the risk posed by gamma radiation from radionuclides in the soil should take into account this shielding effect. The EPA's previous GSF default value—taken from Part B of the *Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual* (EPA 1991)—is 0.8, which assumes that the external gamma radiation level indoors is 20% lower than the outdoor gamma radiation level. This value was not included in the calculation of RBCs for the INL Site provided by Fromm (1996) and was not included in the risk calculations.

The EPA did a further review of the literature presented in the EPA report *Reassessment of Radium and Thorium Soil Concentrations and Annual Dose Rates* (EPA 1996). The review revealed numerous publications that address indoor/outdoor GSFs as applied to radioactive fallout from nuclear weapons and reactor accidents. In the *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)* (EPA 1989), the authors reviewed experimentally measured reduction factors from fallout. The authors concluded that "reduction factors of 0.4 to 0.2 are recommended as representative values for aboveground lightly constructed (wood frame) and heavily constructed (block and brick) homes, respectively." On the basis of that review, EPA (1996) suggests that a default GSF of 0.4 based solely on the contribution of terrestrial radiation might be a more appropriate value to use at sites with soil contaminated with radionuclides than the previous EPA default of 0.8, which also included the effects of cosmic radiation and the inherent radioactivity in structure materials. Based on that rationale, the EPA adopted in its new guidance the value of 0.4 as the default GSF.

To accommodate the fact that in most residential settings the assumption of an infinite slab source will result in overly conservative soil screening levels, an adjustment for source area is considered to be an important modification to the *Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual* Part B model (EPA 1991). Thus, an ACF has been added to the calculation of soil screening levels (EPA 2000). The default is 0.9.

Based on the availability of this new guidance, the State of Idaho is currently in the process of developing a radionuclide calculator and RBCs. When the calculator becomes available or based on the EPA's RBCs, the cleanup values at the INL Site should be evaluated against the new guidance. Although the approach used at the INL Site was extremely conservative to ensure protection of the human receptors and the environment, it is advisable to minimize expenditures for cleanup activities and eliminate unnecessary institutional controls. The new EPA PRG guidance also allows for the development of site-specific PRGs that should also be considered.

A-2.4 Recommendations

Past remediation efforts at the INL Site used RBCs provided by Fromm (1996). Those remediation efforts should be considered effective, because Cs-137 is the primary radionuclide of concern and the remediation activities used a lower, more conservative value than would be required by the new EPA guidance. By cleaning to the more protective level, it is assumed that any other radionuclides that were present would also be at acceptable levels. The changes in the slope factors and guidance on the calculation of radionuclide PRGs presented on the EPA website (http://epa-prgs.ornl.gov/radionuclides/) should be incorporated into all future assessments and cleanup at the INL Site. This includes the new slope factors as well as the use of a GSF and an ACF.

The overall remedial action objectives (RAOs) remain the same, because the RAOs are based on a cancer incidence of 1E-04 or a hazard index of less than 1. However, the new information provided by the EPA should supersede the previous remediation goals, and new cleanup goals should be developed.

A-3. NONRADIONUCLIDES

Slope factors and RfDs are constantly being updated as new toxicity data become available. They are primarily developed using the toxicological data from laboratory studies on animals. Human data from epidemiologic studies are used when available. The INL Site personnel obtained most of the RfDs and slope factors used to calculate the health risk limits from the IRIS, an electronic database containing health risk and regulatory information on more than 500 chemicals. The EPA acknowledges IRIS as the source for reference doses and slope factors that have undergone the most thorough and standardized scientific review.

Table A-3 is a compilation of the contaminants of potential concern (COPCs) identified at each WAG undergoing a five-year review; the table also presents the toxicity values used in the associated risk assessment. The values for chronic oral and inhalation RfDs and chronic oral and inhalation slope factors are compared to those currently presented in IRIS. A higher toxicity value indicates greater toxicity. A lower toxicity value indicates less toxicity. Therefore, if a toxicity value has changed from that used in a risk assessment and the new value is less than the old, then the risk assessment is overly conservative. However, if the new value is higher, then it is possible that the risk assessment was not conservative enough. As can be seen, the toxicity factors for several of the contaminants have changed. Most of the changes are less than an order of magnitude larger. Generally, the radionuclides drive cleanup activities at INL sites; therefore, any of the changes would be unlikely to have an impact on previous remediation decisions.

The largest changes are in the area of the development of new and more realistic inhalation values. The slope factors for inhalation appear to present some of the largest changes, with new values now available for polychlorinated biphenyls (PCBs). The inhalation RfDs also have changed but not to the same extent. These changes are not expected to make a significant impact on the results of any of the baseline risk assessment results currently under five-year review.

The comprehensive remedial investigations/feasibility studies (RI/FSs) at the INL Site use conceptual site models to identify for assessment the following exposure scenarios, exposure pathways, and exposure routes:

- Exposure scenarios
  - Current occupational
  - Future occupational
  - Residential intrusion
- Exposure pathways
  - Groundwater
  - Air captured
- Soil exposure routes
  - Ingestion
    - Soil
    - Groundwater (residential intrusion scenario only)
    - Homegrown produce (residential intrusion scenario only)
  - Inhalation
    - Fugitive dust
    - Volatiles from soil.

For inhalation, all retained sites that have contamination in the top 10 ft of soil are assumed to have a contaminant source that can be released into the air pathway. The exposure routes that are evaluated as part of the air pathway analysis are as follows:

- Inhalation of fugitive dust
- Inhalation of volatiles.

The concentration of each COPC in the respirable particulate matter is assumed to equal the average soil concentration. Averaging contaminant concentrations above the site for the air pathway produces one contaminant-specific risk estimate for each air pathway exposure route (i.e., for each time period, each air pathway exposure route has the same risk or hazard index at every retained site). The equations used were designed to produce high estimates of airborne COPC concentrations, because no credit is taken for dilution of airborne concentrations caused by dust blown from uncontaminated areas of the INL Site.

To quantify risks for the future residential receptor, contaminant concentrations in groundwater were modeled. For the groundwater pathway analysis, every contaminant that is not eliminated by the contaminant screening process was assumed to have the potential for migrating to groundwater. The following exposure routes are evaluated as part of the groundwater pathway analysis:

- Ingestion of groundwater
- Dermal absorption of groundwater
- Inhalation of volatiles produced by indoor use of groundwater.

This approach generally has resulted in inhalation being a minor contributor to the total risk. Table A-4 shows a comparison of the changes to risk if the inhalation is reevaluated for the future resident based on the WAG 5 Operable Unit (OU) 5-12 comprehensive RI/FS (DOE-ID 1999). Only the risk from fugitive dust will be evaluated, because there was no risk from volatiles in soil or groundwater at WAG 5 (DOE-ID 1999, Appendix B).

As is shown in Table A-4, WAG 5 was broken into six groups. As discussed above, the fugitive dust was calculated across these groups and then added back into the total risk by site. The total risk by each site is compared to the percent of risk contributed by fugitive dust. As can be seen, all but the ARA-24 site has inhalation risk that contributes more than 0.1% to the total risk. Table A-3 was evaluated to determine the COPCs that had major changes in their slope factors, and the risk from these COPCs is addressed individually. Many of the PCBs now have a slope factor to calculate risk, and they have been included; cadmium has increased from 1.8E-03 to 6.3 and has been included; chromium (VI) has increased from 1.2E-02 to 4.2E+01 and is discussed; and arsenic is included, because it is one of the largest contributors from risk.

Table A-4 presents both the original results and the recalculated results. Although a cadmium slope factor was presented in Table B-20 of the OU 5-12 RI/FS, the cadmium slope factor was not calculated. In addition, a thallium slope factor for inhalation is not presented in Table B-20, but it is assumed that the ingestion slope factor was to calculate the value presented for conservatism. Additionally, although only total chromium was sampled for at WAG 5 sites (DOE-ID 1999, Appendix B), the risk assessment assumed that both chromium (III) and chromium (VI) were represented by the total chromium concentration. Chromium is most likely to be in a chromium (III) form at the INL Site, and assuming that the total concentration contains a large portion of chromium (VI) in the soil is unrealistic. Chromium should be assessed as chromium (III), because chromium is not expected to persist in the environment at the INL Site in the chromium (VI) form (Bartlett and Kimble 1976; Rai, Eary, and Zachara 1989). Sample data collected from 10 grid locations at the PBF-10 site (a dried pond site) for both chromium (VI) and (III) support this assumption. The average ratio of the chromium (VI) to (III) soil concentrations is 0.0085 (ranging from 0.00017 to 0.053). Based on the total chromium sampling, the intake of chromium (VI) was calculated to be 1.44E-10 mg/kg-day (DOE-ID 1999, Table B-60). Based on the average ratio of chromium (VI) to chromium (III) (as calculated from PBF-10 data), this should be reduced to 1.2E-12 mg/kg-day (i.e., 0.0085 times 1.44E-10 mg/kg-day) for Group 1 and 2.6E-10 mg/kg-day (i.e., 0.0085 times 3.18E-08 mg/kg-day) for Group 2. Therefore, the risk from inhalation of chromium (VI) was recalculated using these more realistic assumptions.

Based on these observations and new information, the risk contribution from inhalation decreases at all sites, as shown in Table A-4. The risk driver for the ARA-24 site was the risk of inhalation of chromium. This is still the largest contributor to total risk, but based on this more realistic approach, the risk is now lower than before even when using the larger slope factors.

In summary, it is apparent that inhalation is not a driver in the risk assessments using the approach accepted at the INL Site. The changes made to the slope factors and RfDs should not impact the conclusions made in the individual WAG comprehensive baseline risk assessment. Currently, the EPA is including the evaluation of indoor air quality due to particulates emitted from soil for both residents and workers. If the risk assessment approach is updated at the INL Site, the inclusion of this exposure route should be considered.

A-4. REFERENCES

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Table A-1. Comparison of 2001 slope factors to 1995 values.

Isotope	from HEAST 2001						from HEAST 1995			Is new slope factor greater than (+) or less than (-) old? How many times greater? (The lower the slope factor the less the risk.)					
	Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Max Ingestion Slope Factor (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External (Risk/y per pCi)	Ingestion		Inhalation			External
Ag-108m	8.14E-12	1.12E-11	1.92E-11	1.92E-11	2.67E-11	7.18E-06	6.05E-12	7.02E-11	5.61E-06	+	—	-	—	+	1.3
Am-241	1.04E-10	1.34E-10	2.17E-10	2.17E-10	2.81E-08	2.76E-08	3.28E-10	3.85E-08	4.59E-09	-	—	-	—	+	6.0
Ba-133	6.81E-12	9.44E-12	1.39E-11	1.39E-11	1.16E-11	1.44E-06	2.70E-12	4.03E-12	9.15E-07	+	—	+	—	+	1.6
Bi-212	7.10E-13	9.99E-13	1.78E-12	1.78E-12	7.77E-11	8.87E-07	6.20E-13	3.65E-11	6.67E-07	+	—	+	—	+	1.3
Bi-214	1.92E-13	2.65E-13	4.33E-13	4.33E-13	2.90E-11	7.48E-06	1.95E-13	1.46E-11	6.02E-06	+	—	+	—	+	1.2
Ce-144+D	3.53E-11	5.19E-11	1.02E-10	1.02E-10	1.10E-10	2.44E-07	2.97E-11	1.08E-10	1.56E-07	+	3.4	+	1.0	+	1.6
C-14	1.55E-12	2.00E-12	2.79E-12	2.79E-12	7.07E-12	7.83E-12	1.03E-12	6.99E-15	No SF	+	2.7	+	1011.4	+	a
Co-57	1.04E-12	1.49E-12	2.78E-12	2.78E-12	2.09E-12	3.55E-07	9.70E-13	2.90E-12	2.10E-07	+	2.9	-	—	+	1.7
Co-58	2.95E-12	4.18E-12	7.44E-12	7.44E-12	5.99E-12	4.48E-06	2.80E-12	5.20E-12	3.70E-06	+	2.7	+	1.2	+	1.2
Co-60	1.57E-11	2.23E-11	4.03E-11	4.03E-11	3.58E-11	1.24E-05	1.89E-11	6.88E-11	9.76E-06	+	2.1	-	—	+	1.3
Cs-134	4.22E-11	5.14E-11	5.81E-11	5.81E-11	1.65E-11	7.10E-06	4.73E-11	2.89E-11	5.88E-06	+	1.2	-	—	+	1.2
Cs-137+D	3.04E-11	3.74E-11	4.33E-11	4.33E-11	1.19E-11	2.55E-06	3.16E-11	1.91E-11	2.09E-06	+	1.4	-	—	+	1.2
Cm-242	3.85E-11	5.48E-11	1.05E-10	1.05E-10	1.51E-08	7.73E-11	3.83E-11	3.16E-09	2.34E-11	+	2.7	+	4.8	+	3.3
Cm-244	8.36E-11	1.08E-10	1.81E-10	1.81E-10	2.53E-08	4.85E-11	2.11E-10	2.43E-08	2.07E-11	-	—	+	1.0	+	2.3
Eu-152	6.07E-12	8.70E-12	1.62E-11	1.62E-11	9.10E-11	5.30E-06	5.73E-12	7.91E-11	4.08E-06	+	2.8	+	1.2	+	1.3
Eu-154	1.03E-11	1.49E-11	2.85E-11	2.85E-11	1.15E-10	5.83E-06	9.37E-12	9.15E-11	4.65E-06	+	3.0	+	1.3	+	1.3
Eu-155	1.90E-12	2.77E-12	5.40E-12	5.40E-12	1.48E-11	1.24E-07	1.65E-12	9.60E-12	6.08E-08	+	3.3	+	1.5	+	2.0
H-3 (organic)	1.12E-13	1.44E-13	2.20E-13	2.20E-13	1.99E-13	No SF	7.15E-14	9.59E-14	No SF	+	3.1	+	2.1	+	NA
H-3 (vapor)	5.07E-14	6.51E-14	9.25E-14	9.25E-14	5.62E-14	No SF	No SF	No SF	No SF	NA	NA	NA	NA	NA	NA
I-129	1.48E-10	3.22E-10	2.71E-10	3.22E-10	6.07E-11	6.10E-09	1.84E-10	1.22E-10	2.69E-09	+	1.8	-	—	+	2.3
Fe-55	8.62E-13	1.16E-12	2.09E-12	2.09E-12	7.99E-13	No SF	3.51E-13	5.60E-13	No SF	+	6.0	+	1.4	+	—
Pb-214	3.44E-13	4.85E-13	8.51E-13	8.51E-13	3.63E-11	9.82E-07	2.94E-13	6.23E-12	7.09E-07	+	2.9	+	5.8	+	1.4
Mn-54	2.28E-12	3.11E-12	5.14E-12	5.14E-12	5.88E-12	3.89E-06	1.96E-12	3.69E-12	3.26E-06	+	2.6	+	1.6	+	1.2
Np-237+D	6.74E-11	9.10E-11	1.62E-10	1.62E-10	1.77E-08	7.97E-07	3.00E-10	3.45E-08	4.62E-07	-	—	-	—	+	1.7
Ni-59	2.74E-13	3.89E-13	7.33E-13	7.33E-13	4.66E-13	No SF	1.85E-13	4.01E-13	No SF	+	4.0	+	1.2	+	—
Ni-63	6.70E-13	9.51E-13	1.79E-12	1.79E-12	1.64E-12	No SF	5.50E-13	1.01E-12	No SF	+	3.3	+	1.6	+	—
Nb-95	2.45E-12	3.50E-12	6.36E-12	6.36E-12	5.44E-12	3.53E-06	2.30E-12	3.10E-12	2.90E-06	+	2.8	+	1.8	+	1.2
Pu-238	1.31E-10	1.69E-10	2.72E-10	2.72E-10	3.36E-08	7.22E-11	2.95E-10	2.74E-08	1.94E-11	-	—	+	1.2	+	3.7
Pu-239	1.35E-10	1.74E-10	2.76E-10	2.76E-10	3.33E-08	2.00E-10	3.16E-10	2.78E-08	1.26E-11	-	—	+	1.2	+	15.9
Pu-240	1.35E-10	1.74E-10	2.77E-10	2.77E-10	3.33E-08	6.98E-11	3.15E-10	2.78E-08	1.87E-11	-	—	+	1.2	+	3.7

Table A-1. (continued).

Isotope	from HEAST 2001						from HEAST 1995			Is new slope factor greater than (+) or less than (-) old? How many times greater? (The lower the slope factor the less the risk.)					
	Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Max Ingestion Slope Factor (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External (Risk/y per pCi)	Ingestion		Inhalation			External
Pu-241[b]	1.76E-12	2.28E-12	3.29E-12	3.29E-12	3.34E-10	4.11E-12	3.33E-10	3.88E-08	4.59E-09	-	—	-	—	-	—
Pu-242	1.28E-10	1.65E-10	2.63E-10	2.63E-10	3.13E-08	6.25E-11	3.00E-10	2.64E-08	1.55E-11	-	—	+	1.2	+	4.0
K-40	2.47E-11	3.43E-11	6.18E-11	6.18E-11	1.03E-11	7.97E-07	1.25E-11	7.46E-12	6.11E-07	+	4.9	+	1.4	+	1.3
Ra-226 +D	3.86E-10	5.15E-10	7.30E-10	7.30E-10	1.16E-08	8.49E-06	2.96E-10	2.75E-09	6.74E-06	+	2.5	+	—	+	1.3
Ru-106+D	4.22E-11	6.11E-11	1.19E-10	1.19E-10	1.02E-10	9.66E-07	3.45E-11	1.15E-10	7.57E-07	+	3.4	-	—	+	1.3
Sb-125+D	5.13E-12	7.21E-12	1.32E-11	1.32E-11	1.93E-11	1.81E-06	3.54E-12	5.85E-12	1.34E-06	+	3.7	+	3.3	+	1.4
Sr-90+D	7.40E-11	9.53E-11	1.44E-10	1.44E-10	1.13E-10	1.96E-08	5.59E-11	6.93E-11	No SF	+	2.6	+	1.6	+	a
Tc-99	2.75E-12	4.00E-12	7.66E-12	7.66E-12	1.41E-11	8.14E-11	1.40E-12	2.89E-12	6.19E-13	+	5.5	+	4.9	+	131.5
Th-228+D	3.00E-10	4.22E-10	8.09E-10	8.09E-10	1.43E-07	7.76E-06	2.31E-10	9.68E-08	9.94E-07	+	3.5	+	1.5	+	7.8
Th-230	9.10E-11	1.19E-10	2.02E-10	2.02E-10	2.85E-08	8.19E-10	3.75E-11	1.72E-08	4.40E-11	+	5.4	+	1.7	+	18.6
Th-232	1.01E-10	1.33E-10	2.31E-10	2.31E-10	4.33E-08	3.42E-10	3.28E-11	1.93E-08	1.97E-11	+	7.0	+	2.2	+	17.4
U-232	2.92E-10	3.85E-10	5.74E-10	5.74E-10	1.95E-08	5.98E-10	8.12E-11	5.29E-08	3.42E-11	+	7.1	-	—	+	17.5
U-233	7.18E-11	9.69E-11	1.60E-10	1.60E-10	1.16E-08	9.82E-10	4.50E-11	1.40E-08	3.50E-11	+	3.6	-	—	+	28.1
U-234	7.07E-11	9.55E-11	1.58E-10	1.58E-10	1.14E-08	2.52E-10	4.44E-11	1.40E-08	2.14E-11	+	3.6	-	—	+	11.8
U-235+D	7.18E-11	9.76E-11	1.63E-10	1.63E-10	1.01E-08	5.43E-07	4.70E-11	1.30E-08	2.65E-07	+	3.5	-	—	+	2.0
U-236	6.70E-11	9.03E-11	1.49E-10	1.49E-10	1.05E-08	1.25E-10	4.21E-11	1.32E-08	1.72E-11	+	3.5	-	—	+	7.3
U-238+D	8.71E-11	1.21E-10	2.10E-10	2.10E-10	9.35E-09	1.14E-07	6.20E-11	1.24E-08	5.25E-08	+	3.4	-	—	+	2.2
Zn-65	1.17E-11	1.54E-11	2.45E-11	2.45E-11	5.81E-12	2.81E-06	9.93E-12	9.98E-12	2.27E-06	+	2.5	-	—	+	1.2
Zr-93	1.11E-12	1.44E-12	2.12E-12	2.12E-12	7.29E-12	No SF	5.21E-13	5.26E-12	No SF	+	4.1	+	1.4	NA	NA
Zr-95	4.59E-12	6.59E-12	1.23E-11	1.23E-11	1.65E-11	3.40E-06	3.92E-12	6.48E-12	2.81E-06	+	3.1	+	2.5	-	1.2

Note: For tritium, two sets of values are provided for ingestion and inhalation pathways. The values in the first line represent ingestion of H-3 in the form of tritiated water and inhalation of tritiated water vapor, while values in the second line represent ingestion of organically bound tritium and inhalation of H-3 in particulate form (with default International Commission on Radiological Protection lung absorption Type M). The corresponding value for inhalation of H-3 in organically bound gas would be greater than the value for tritiated water vapor by a factor of 2.3, while the value for inhalation of elemental hydrogen gas would be lower by a factor of 10,000. Fromm (1996) did not differentiate these factors.

a. There were no external exposure values in the 1995 HEAST.
b. Pu-241 was assessed with its daughter product in 1996 (Fromm 1996). However, the new HEAST does not present this radionuclide with its daughter.

HEAST = Health Effects Assessment Summary Table
NA = not applicable

Table A-2. Comparison of 1996 risk-based concentrations with U.S. Environmental Protection Agency preliminary remediation goals.

Isotope	Risk-Based Concentration from Fromm (1996)			PRGs						Soil to Groundwater		EPA PRG for Residential Soil Decayed to 2095 (pCi/g)	EPA PRG is greater (+) or less (-) than old? How many times less?					
	Future Resident (pCi/g)	Current Resident (pCi/g)	Current Worker (pCi/g)	Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/gL)	Fish Ingestion (pCi/g)	DAF = 20 (pCi/g)	DAF = 1 (pCi/g)		Current Worker		Current Resident		Future 2095 Resident	
Ag-108m	NA	NA	NA	1.68E-02	6.29E-03	3.25E-02	7.32E-02	5.85E+00	1.57E-01	3.99E-01	1.99E-02	2.75E-02	NA	NA	NA	NA	NA	NA
Am-241	2.90E+00	2.50E+00	1.00E+01	1.87E+00	1.32E-02	5.67E+00	1.19E+01	4.58E-01	1.32E-02	2.58E+00	1.29E-01	2.16E+00	-	1.8	-	46.6	-	46.6
Ba-133	NA	NA	NA	1.75E-01	1.61E-01	3.06E-01	6.89E-01	6.99E+00	1.87E-01			5.96E+01	NA	NA	NA	NA	NA	NA
Bi-212	NA	NA	NA	2.26E+04	2.24E+04	3.70E+04	8.33E+04	6.71E+01	1.77E+00			5.24E+09	NA	NA	NA	NA	NA	NA
Bi-214	NA	NA	NA	8.19E+03	8.19E+03	1.34E+04	3.01E+04	2.48E+02	6.66E+00			1.78E+20	NA	NA	NA	NA	-	NA
Ce-144+D	2.90E+39	1.50E+01	6.30E+01	1.14E+01	3.45E+00	1.99E+01	4.49E+01	1.35E+00	3.40E-02	5.64E+02	2.82E+01	7.53E+35	-	3.2	-	1.3	+	3,851.7
C-14	7.90E+02	7.80E+02	3.10E+03	4.56E-01	5.63E-05	1.23E+03	2.24E+03	1.29E+00	8.82E-01	4.01E+01	2.00E+00	4.61E-01	-	2.5	-	1,710.5	-	1,713.7
Co-57	NA	NA	NA	8.73E+00	9.66E-02	1.44E+01	3.23E+01	4.58E+01	1.18E+00	1.68E+02	8.40E+00	2.70E+37	NA	NA	NA	NA	NA	NA
Co-58	NA	NA	NA	2.66E+00	1.27E-01	4.36E+00	9.80E+00	1.61E+01	4.22E-01	1.11E+03	5.56E+01	1.25E+140	NA	NA	NA	NA	NA	NA
Co-60	7.40E+03	1.60E-02	7.20E-02	3.61E-02	9.01E-04	6.02E-02	1.35E-01	3.03E+00	7.91E-02	2.41E+00	1.21E-01	4.99E+03	-	1.2	+		+	1.5
Cs-134	2.40E+13	8.40E-02	3.60E-01	1.57E-01	7.47E-03	2.59E-01	5.82E-01	1.13E+00	3.43E-02	1.65E+02	8.24E+00	2.23E+12	-	1.4	+		+	10.8
Cs-137+D	2.30E-01	2.40E-02	1.20E-01	5.97E-02	1.20E-03	1.13E-01	2.53E-01	1.57E+00	4.72E-02	5.66E+01	2.83E+00	4.78E-01	-	1.1	+		+	
Cm-242	2.40E+70	4.60E+03	1.50E+04	3.22E+02	1.89E+01	3.20E+03	5.92E+03	1.24E+00	3.22E-02	4.62E+03	2.31E+02	1.50E+63	-	4.7	-	14.3	-	16,019,678.3
Cm-244	2.90E+02	6.60E+00	2.40E+01	6.69E+00	3.04E-01	3.79E+01	6.90E+01	5.70E-01	1.63E-02	4.35E+01	2.17E+00	2.10E+02	+		+		+	1.4
Eu-152	2.70E+00	1.80E-02	8.20E-02	4.16E-02	3.76E-02	7.37E-02	1.66E-01	7.84E+00	2.03E-01			4.53E+00	-	1.1	+		+	
Eu-154	5.20E+01	2.10E-02	9.60E-02	4.99E-02	4.72E-02	8.57E-02	1.93E-01	4.62E+00	1.18E-01			5.98E+01	-	1.1	+		+	2.6
Eu-155	2.90E+06	2.80E+00	1.20E+01	3.80E+00	3.74E+00	6.34E+00	1.43E+01	2.51E+01	6.37E-01			1.10E+06	-	1.9	+		+	
H-3 (organic)	6.50E+06	2.50E+04	8.80E+04	2.28E+00	1.60E-01	1.42E+00	3.20E+00		1.22E+01			3.49E+02	-	61,971.8	-	10,964.9	-	18,624.4
H-3 (vapor)	NA	NA	NA					1.44E+02		1.65E+02	8.25E+00		NA	NA	NA	NA	NA	NA
I-129	4.30E+00	4.30E+00	1.70E+01	5.96E-01	2.76E-05	1.09E+01	2.08E+01	3.22E-01	5.48E-03	4.60E-03	2.30E-04	5.96E-01	-	1.6	-	7.2	-	7.2
Fe-55	2.50E+15	2.30E+04	7.60E+04	2.69E+03	8.21E-01	2.21E+04	3.97E+04	5.52E+01	1.52E+00	1.02E+03	5.08E+01	2.91E+13	-	3.4	-	8.6	-	85.9
Pb-214	1.40E+13	6.30E-01	2.70E+00	4.63E+04	3.49E+04	7.56E+04	1.70E+05	1.38E+02	3.64E+00	2.85E+12	1.43E+11	6.26E+16	+		+		+	
Mn-54	3.30E+34	5.80E-01	2.50E+00	6.92E-01	3.69E-01	1.13E+00	2.55E+00	2.09E+01	5.67E-01	7.42E+02	3.71E+01	2.72E+31	-	2.2	+		+	1,215.3
Np-237+D	7.60E-02	7.60E-02	3.90E-01	1.30E-01	4.48E-04	2.72E-01	6.11E-01	7.07E-01	1.94E-02	9.00E-02	4.50E-03	1.30E-01	-	1.4	+		+	
Ni-59	4.30E+03	4.30E+03	1.70E+04	2.08E+02	2.15E+00	1.23E+04	2.22E+04	1.74E+02	4.53E+00	2.05E+02	1.03E+01	2.08E+02	-	1.4	-	20.7	-	20.7
Ni-63	3.20E+03	1.60E+03	6.40E+03	9.48E+01	1.01E+00	5.55E+03	9.99E+03	7.11E+01	1.85E+00	3.80E+01	1.90E+00	1.82E+02	-	1.2	-	16.9	-	17.6
Nb-95	NA	NA	NA	6.81E+00	6.81E+00	1.11E+01	2.50E+01	1.94E+01	5.04E-01			5.83E+281	-	NA	-	NA	NA	NA
Pu-238	6.70E+00	3.10E+00	1.20E+01	2.97E+00	7.31E-03	1.60E+01	2.91E+01	3.64E-01	1.04E-02	1.75E+00	8.76E-02	6.05E+00	+		-	1.0	-	1.1
Pu-239	2.50E+00	2.50E+00	1.00E+01	2.59E+00	6.09E-03	1.40E+01	2.54E+01	3.53E-01	1.01E-02	1.56E+00	7.80E-02	2.60E+00	+		+		+	
Pu-240	2.60E+00	2.50E+00	1.00E+01	2.60E+00	6.10E-03	1.41E+01	2.56E+01	3.53E-01	1.01E-02	1.56E+00	7.81E-02	2.62E+00	+		+		+	

Table A-2. (continued).

Isotope	Risk-Based Concentration from Fromm (1996)			PRGs						Soil to Groundwater		EPA PRG for Residential Soil Decayed to 2095 (pCi/g)	EPA PRG is greater (+) or less (-) than old? How many times less?					
	Future Resident (pCi/g)	Current Resident (pCi/g)	Current Worker (pCi/g)	Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/gL)	Fish Ingestion (pCi/g)	DAF = 20 (pCi/g)	DAF = 1 (pCi/g)		Current Worker		Current Resident		Future 2095 Resident	
Pu-241	5.60E+02	4.80E+00	1.70E+01	4.06E+02	1.05E+00	1.69E+03	3.06E+03	2.71E+01	7.74E-01	1.00E+01	5.02E-01	3.09E+04	+		+		+	
Pu-242	2.70E+00	2.70E+00	1.10E+01	2.73E+00	6.42E-03	1.48E+01	2.69E+01	3.72E-01	1.07E-02	1.56E+00	7.80E-02	2.73E+00	+		+		+	
K-40	5.70E-02	5.70E-02	2.90E-01	1.08E-01	4.45E-02	2.73E-01	6.15E-01	1.93E+00	5.14E-02			1.08E-01	-	1.1	+		+	
Ra-226 +D	5.50E-03	5.20E-03	2.70E-02	1.24E-02	6.32E-04	2.58E-02	5.79E-02	8.16E-04	3.42E-03	3.22E-01	1.61E-02	1.29E-02	-	1.0	+		+	
Ru-106+D	6.90E+29	1.90E+00	8.10E+00	2.25E+00	1.72E-01	3.89E+00	8.74E+00	1.13E+00	2.89E-02	6.43E+01	3.22E+00	1.68E+27	-	2.1	+		+	411.9
Sb-125+D	1.40E+10	2.50E-01	1.10E+00	4.62E-01	4.60E-01	7.56E-01	1.70E+00	9.28E+00	2.45E-01			2.79E+09	-	1.5	+		+	5.0
Sr-90+D	2.30E+02	2.10E+01	7.80E+01	2.31E-01	1.39E-03	1.08E+01	2.27E+01	6.44E-01	1.85E-02	2.69E-01	1.34E-02	1.97E+00	-	7.2	-	90.9	-	116.7
Tc-99	5.70E+02	5.70E+02	2.30E+03	2.50E-01	5.57E-03	8.96E+02	1.73E+03	1.73E+01	4.41E-01	3.73E+00	1.86E-01	2.50E-01	-	2.6	-	2,280.0	-	2,279.3
Th-228+D	2.20E+15	5.50E-01	2.40E+00	1.54E-01	3.38E-02	2.55E-01	5.73E-01	1.59E-01	4.18E-03	6.60E+01	3.30E+00	2.36E+13	-	9.4	-	3.6	-	93.4
Th-230	2.10E+01	2.10E+01	8.50E+01	3.49E+00	1.05E-02	2.02E+01	3.72E+01	5.23E-01	1.48E-02	6.06E+00	3.03E-01	3.49E+00	-	4.2	-	6.0	-	6.0
Th-232	2.40E+01	2.40E+01	9.80E+01	3.10E+00	9.42E-03	1.90E+01	3.48E+01	4.71E-01	1.33E-02	6.06E+00	3.03E-01	3.10E+00	-	5.2	-	7.7	-	7.7
U-232	3.00E+01	1.10E+01	4.50E+01	1.25E+00	5.59E-04	7.92E+00	1.43E+01	1.63E-01	4.58E-03	8.86E+06	4.43E+05	2.97E+00	-	5.7	-	8.8	-	10.1
U-233	NA	NA	NA	3.86E+00	1.84E-03	2.87E+01	5.34E+01	6.63E-01	1.82E-02	3.47E+03	1.74E+02	3.86E+00	-	NA	-	NA	-	NA
U-234	1.80E+01	1.80E+01	7.20E+01	4.01E+00	1.87E-03	3.24E+01	5.92E+01	6.74E-01	1.85E-02	2.24E+03	1.12E+02	4.01E+00	-	2.2	-	4.5	-	4.5
U-235+D	1.30E-01	1.30E-01	6.80E-01	1.95E-01	1.81E-03	3.98E-01	8.92E-01	6.63E-01	1.81E-02	7.77E-01	3.89E-02	1.95E-01	-	1.7	+		+	
U-236	1.90E+01	1.90E+01	7.60E+01	4.27E+00	1.98E-03	3.48E+01	6.33E+01	7.11E-01	1.95E-02	2.33E+01	1.16E+00	4.27E+00	-	2.2	-	4.4	-	4.4
U-238+D	6.70E-01	6.70E-01	3.40E+00	7.42E-01	1.47E-03	1.80E+00	4.00E+00	5.47E-01	1.46E-02	1.21E-01	6.04E-03	7.42E-01	-	1.9	+		+	
Zn-65	5.00E+44	1.40E+00	5.80E+00	1.18E+00	3.01E-03	2.01E+00	4.53E+00	4.07E+00	1.15E-01	5.60E+01	2.80E+00	3.98E+40	-	2.9	-		+	12,562.4
Zr-93	1.50E+03	1.50E+03	6.10E+03	3.38E+02	2.00E+02	1.81E+03	3.26E+03	4.29E+01	1.22E+00			3.38E+02	-	3.4	-	4.4	-	4.4
Zr-95	NA	NA	NA	3.89E+00	3.89E+00	6.35E+00	1.43E+01	1.04E+01	2.68E-01			1.27E+155	NA	NA	NA	NA	NA	NA

EPA = U.S. Environmental Protection Agency
NA = not applicable
PRG = preliminary remediation goal

Table A-3. Comparison of slope factors and reference doses used in the risk assessment to new values in the Integrated Risk Information System.

COPCs	WAG	Contaminant Type	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	New Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	New Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Oral RfD (mg/kg-day)	New Oral RfD (mg/kg-day)	Is new greater than or less than old?	Inhalation RfD (mg/kg-day)	New Inhalation RfD (mg/kg-day)	Is new greater than or less than old?	Comments
Acenaphthene	1	Organic		—	—	—	—	—	6.00E-02	6.00E-02[a]	Same	—	—	—	—
Acetone	2	Organic	—	—	—	—	—	—	1.00E-01	9.00E-01[a]	Greater	—	—	—	—
Acrylonitrile	2	Organic	5.40E-01	5.40E-01[a]	Same	5.70E-04	2.38E-01[a]	Greater	1.00E-03	1.00E-03[a]	Same	5.70E-04	5.71E-04	Same	—
Anthracene	2	Organic		—	—	—	—	—	3.00E-01	3.00E-01[a]	Same	—	—	—	—
Aroclor-1242	5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	—	—	—	—	—	—	—
Aroclor-1248	5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	—	—	—	—	—	—	—
Aroclor-1254	4,5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	2.00E-05	2.00E-05[a]	Same	—	—	—	—
Aroclor-1260	1,2,3	Organic	7.70E+00	4.00E-01[a]o	Less	—	3.50E-01[a]	New	—	—		—	—	—	—
Aroclor-1260	4	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	2.00E-05	—	Used 1254	—	—	—	—
Aroclor 1260[b]	5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	—	—	—	—	—	—	—
Benzo[a]anthracene	1	Organic	7.30E-01	7.30E-01	Same	6.10E-01	—	—	—	—	—	—	—	—	—
Benzo[a]anthracene	4	Organic	7.30E-01	7.30E-01	Same	3.10E-01	—	—	—	—	—	—	—	—	—
Benzo[b]fluoranthene	1,2	Organic	7.30E-01	7.30E-01[a]	Same	6.10E-01	3.08E-01[a]	Less	—	—	—	—	—	—	—
Benzo[b]fluoranthene	4	Organic	7.30E-01	7.30E-01[a]	Same	3.10E-01	3.08E-01[a]	Same	—	—	—	—	—	—	—
Benzo[a]pyrene	1	Organic	7.30E+00	7.30E+00[a]	Same	6.00E+00	3.08E+00[a]	Less	—	—	—	—	—	—	—
Benzo[a]pyrene	3	Organic	7.30E+00	7.30E+00[a]	Same	6.10E-01	3.08E+00[a]	Greater	—	—	—	—	—	—	—
Benzo[g,h,i]perylene	4	Organic	7.30E-01	—	Less	3.10E-01	—	Less	—	—	—		—	—	Used benzo(a)pyrene values for screening
Bis(2-ethylhexyl)phthalate	2,5	Organic	1.40E-02	1.40E-02[a]	Same	—	—	Same	2.00E-02	2.00E-02[a]	Same	—	—	—	—
Butyl benzyl phthalate	2	Organic	—	—	—	—	—	Same	2.00E-01	2.00E-01[a]	Same	—	—	—	—
Carbon disulfide	2	Organic	—	—		—	—	Same	1.00E-01	1.00E-01[a]	Same	2.90E-03	2.00E-01	Greater	—
Carbon tetrachloride	2	Organic	1.30E-01	1.30E-01[a]	Same	5.25E-02	5.25E-02[a]	Same	7.00E-04	7.00E-04[a]	Same	5.70E-04	—	Less	—
Chloroaniline, p-	2	Organic	—	—	—	—	—	Same	4.00E-03	4.00E-03[a]	Same	—	—	—	—
Chloroform	2	Organic	6.10E-03	6.10E-03[a]	Same	8.05E-02	8.05E-02[a]	Same	1.00E-02	1.00E-02[a]	Same	—	—	—	—
Chrysene	2	Organic	7.30E-03	7.30E-03[a]	Same	—	3.08E-03[a]	New	—	—	—	—	—	—	—
DDT	2	Organic	3.40E-01	3.40E-01[a]	Same	3.40E-01	3.40E-01[a]	Same	5.00E-04	5.00E-04[a]	Same	—	—	—	—
Dibenzofuran	2	Organic	—	—	—	—	—	—	4.00E-03	4.00E-03[a]	Same	—	—	—	—
Dibutyl Phthalate	2,4	Organic	—	—	—	—	—	—	1.00E-01	1.00E-01[a]	Same	—	—	—	—
Dichlorobenzene, 1,4-	2,5	Organic	2.40E-02	2.40E-02[a]	Same	—	—	—	3.00E-02	—	—	2.30E-01	2.29E-01	Same	—
Dichloroethylene, 1,1-	5	Organic	6.00E-01	6.00E-01[a]	Same	1.20E+00	1.75E-01[a]	Less	9.00E-03	5.00E-02[a]	Greater	—	5.71E-02	Less	—
Dichlorodifluoromethane	1	Organic	—	—	—	—	—	—	2.00E-01	2.00E-01[a]	Same	5.71E-02	5.71E-02	Same	—
Dichloroethylene, 1,2-cis-	1	Organic	—	—	—	—	—	—	9.00E-03	1.00E-02	Greater	—	—	—	—
Dichloroethylene, 1,2-trans-	1	Organic	—	—	—	—	—	—	9.00E-03	2.00E-02[a]	Greater	—	—	—	—
Dimethylphenol, 2,4-	2	Organic	—	—	—	—	—	—	2.00E-02	2.00E-02[a]	Same	—	—	—	—
Dinitrotoluene, 2,4-	2	Organic	—	6.80E-01[a]	New	—	—	—	2.00E-03	2.00E-03[a]	Same	—	—	—	—
Fluoranthene	2	Organic	—	—	—	—	—	—	4.00E-02	4.00E-02[a]	Same	—	—	—	—
Fluorene	2	Organic	—	—	—	—	—	—	4.00E-02	4.00E-02[a]	Same	—	—	—	—
Indeno[1,2,3-cd]pyrene	2	Organic	7.30E-01	7.30E-01[a]	Same	—	3.08E-01[a]	New	—	—	—	—	—	—	—
Isophorone	2	Organic	9.50E-04	9.50E-04[a]	Same	—	—	—	2.00E-02	2.00E-01[a]	Same	—	—	—	—

Table A-3. (continued).

COPCs	WAG	Contaminant Type	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	New Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	New Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Oral RfD (mg/kg-day)	New Oral RfD (mg/kg-day)	Is new greater than or less than old?	Inhalation RfD (mg/kg-day)	New Inhalation RfD (mg/kg-day)	Is new greater than or less than old?	Comments
Octyl phthalate, di-N-	1,2	Organic	—	—	—	—	—	—	2.00E-02	4.00E-02	Greater	—	—	—	—
Chlordecone (Kepone)	3	Organic	—	8.00E+00	New	—	—	—	—	2.00E-04	New	—	—	—	—
Methylene chloride	2	Organic	7.50E-03	7.50E-03[a]	Same	1.64E-03	1.65E-03[a]	Same	6.00E-02	6.00E-02[a]	Same	8.60E-01	8.57E-01	Same	—
Methylphenol, 4	2	Organic		—	—	—	—	—	—	—	—	—	—	—	—
Naphthalene, 2-methyl	2	Organic	—	—	—	—	—	—	—	4.00E-03[a]	New	—	—	—	—
Naphthalene	1,2	Organic	—	—	—	—	—	—	4.00E-02	2.00E-02[a]	Less	—	8.57E-04	New	—
Nitrobenzene	2	Organic	—	—	—	—	—	—	5.00E-04	5.00E-04[a]	Same	5.71E-04	5.71E-04	Same	—
Nitrophenol, 2	2	Organic	—	—	—	—	—	—	—	—	—	—	—	—	—
Phenanthrene	2,3,5	Organic	—	—	—	—	—	—	—	—	—	—	—	—	—
Phenanthrene	4	Organic	—	—	—	—	—	—	4.00E-03	—	?	—	—	—	—
Phenol	2	Organic	—	—	—	—	—	—	6.00E-01	3.00E-01[a]	Less	—	—	—	—
Pyrene	2	Organic	—	—	—	—	—	—	3.00E-02	3.00E-02[a]	Same	—	—	—	—
Tetrachloroethane, 1,1,2,2-	2	Organic	2.00E-01	2.00E-01[a]	Same	2.00E-01	2.03E-01[a]	Same	—	6.00E-02	New	—	—	—	—
Tetrachloroethylene	1,2,5	Organic	5.20E-02	5.20E-02[a]	Same	2.00E-03	2.03E-03[a]	Same	1.00E-02	1.00E-02[a]	Same	1.00E-02	1.71E-01	—	WAGs 2 and 5 did not present an RfD for inhalation.
Tetrahydrofuran	2	Organic	—	—	—	—	—	—	—	—	—	—	—	—	—
Toluene	2	Organic	—	—	—	—	—	—	2.00E-01	2.00E-01[a]	Same	—	1.14E-01	New	—
Toluene	2	Organic	—	—	—	—	—	—	2.00E-01	2.00E-01[a]	Same	—	1.14E-01	New	—
Trichloroethane, 1,1,1-	2	Organic	—	—	—	—	—	—	9.00E-02	2.00E-01[a]	Greater	2.90E-01	6.29E-01	Greater	—
Xylene, mixture	2	Organic	—	—	—	—	—	—	2.00E+00	2.00E-01[a]	Less	—	2.86E-02	New	—
Aluminum	3	Inorganic	—	—	—	—	—	—	1.00E+00	1.00E+00	Same	—	1.43E-03	New	—
Antimony (metallic)	2,5	Inorganic	—	—	—	—	—	—	4.00E-04	4.00E-04[a]	Same	—	—	—	—
Arsenic, inorganic	1	Inorganic	1.50E+00	1.50E+00[a]	Same	5.00E+01	1.51E+01[a]	Less	3.00E-04	3.00E-04[a]	Same	—	—	—	—
Arsenic, inorganic		Inorganic	1.75E+00	1.50E+00[a]	Less	1.50E+00	1.51E+01[a]	Greater	3.00E-04	3.00E-04[a]	Same	—	—	—	—
Arsenic, inorganic	3	Inorganic	1.50E+00	1.50E+00[a]	Same	1.50E+00	1.51E+01[a]	Greater	3.00E-04	3.00E-04[a]	Same	—	—	—	—
Arsenic, inorganic	4	Inorganic	1.50E+00	1.50E+00[a]	Same	1.50E+02	1.51E+01[a]	Less	3.00E-04	3.00E-04[a]	Same	—	—	—	—
Arsenic, inorganic	5	Inorganic	1.80E+00	1.50E+00[a]	Less	1.50E+01	1.51E+01[a]	Same	3.00E-04	3.00E-04[a]	Same	—	—	New	—
Barium	1,2,3,5	Inorganic	—	—	—	—	—	—	7.00E-02	7.00E-02[a]	Same	1.43E-04	1.43E-04	—	—
Beryllium and compounds	2	Inorganic	4.30E+00	4.30E+00[a]	Same	8.40E+00	8.40E+00[a]	Same	5.00E-03	2.00E-03[a]	Less	—	5.71E-06	—	—
Cadmium (diet)	2	Inorganic	—	—	—	6.30E+00	6.30E+00[a]	Same	5.00E-04	1.00E-03[a]	Greater	—	—	—	—
Cadmium (diet)	3	Inorganic	—	—	—	6.30E+00	6.30E+00[a]	Same	1.00E-03	1.00E-03[a]	Same	—	—	—	—
Cadmium (diet)	5	Inorganic	—	—	—	1.80E-03	6.30E+00[a]	Greater	5.00E-04	1.00E-03[a]	Greater	—	—	—	—
Cadmium (water)	—	Inorganic	—	—	—	—	6.30E+00[a]	Same	—	5.00E-04[a]	Same	—	—	—	Used cadmium for water for screening
Chloride	2,3,5	Inorganic	—	—	—	—	—	—	—	—	+	—	—	—	—
Chromium (III) (insoluble salts)	1,2,3	Inorganic	—	—	—	—	—	—	—	1.50E+00[a]	+	—	—	—	—
Chromium (III) (insoluble salts)	5	Inorganic	—	—	—	—1.2E-02	—	Less	1.00E+00	1.50E+00[a]	Greater	—	—	—	—
Chromium VI (particulates)	5	Inorganic	—	—	—	1.20E-02	4.20E+01[a]	Greater	5.00E-03	3.00E-03[a]	Less	—	2.86E-05	New	—

Table A-3. (continued).

COPCs	WAG	Contaminant Type	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	New Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	New Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Oral RfD (mg/kg-day)	New Oral RfD (mg/kg-day)	Is new greater than or less than old?	Inhalation RfD (mg/kg-day)	New Inhalation RfD (mg/kg-day)	Is new greater than or less than old?	Comments
Chromium VI (particulates)	2	Inorganic	—	—	—	2.90E+02	4.20E+01[a]	Less	5.00E-03	3.00E-03[a]	Less	—	2.86E-05	New	—
Cobalt	2,5	Inorganic	—	—	—	—	9.80E+00[a]	New	6.00E-02	2.00E-02	Less	2.90E-04	5.71E-06	Less	—
Copper	2,5	Inorganic	—	—	—	—	—	—	3.70E-02	4.00E-02[a]	Less	—	—	—	—
Fluoride	2	Inorganic	—	—	—	—	—	—	6.00E-02	—	Less	—	—	—	—
Lead and compounds	2,3,4,5	Inorganic	—	—	—	—	—	—	—	—	—	—	—	—	—
Manganese (diet)	1,2,3,5	Inorganic	—	—	—	—	—	—	1.40E-01	1.40E-01[a]	Same	1.40E-05	1.43E-05	Same	—
Manganese (water)	1,2,3	Inorganic	—	—	—	—	—	—	5.00E-03	4.60E-02[a]	Greater	1.40E-05	1.43E-05	—	—
Mercury, inorganic salts	1,3,5	Inorganic	—	—	—	—	—	—	3.00E-04	3.00E-04[a]	Same	8.57E-04	—	—	Conservatively used elemental value for inhalation
Mercury, inorganic salts	4	Inorganic	—	—	—	—	—	—	3.00E-04	3.00E-04[a]	Same	8.57E-05	—	—	Conservatively used elemental value for inhalation
Nickel, soluble salts	5	Inorganic	—	—	—	—	—	—	2.00E-02	2.00E-02[a]	Same	—	—	—	—
Nitrate	2,3	Inorganic	—	—	—	—	—	—	1.60E+00	1.60E+00[a]	Same	—	—	—	—
Nitrite	2	Inorganic	—	—	—	—	—	—	1.00E-01	1.00E-01[a]	Same	—	—	—	—
Osmium	3	Inorganic	—	—	—	—	—	—	—	—	—	—	—	—	—
Orthophosphate	2	Inorganic	—	—	—	—	—	—	—	—	—	—	—	—	—
Selenium	2,5	Inorganic	—	—	—	—	—	—	5.00E-03	5.00E-03[a]	Same	—	—	—	—
Silver	2,5	Inorganic	—	—	—	—	—	—	5.00E-03	5.00E-03[a]	Same	—	—	—	—
Strontium, stable	2	Inorganic	—	—	—	—	—	—	6.00E-01	6.00E-01[a]	Same	—	—	—	—
Sulfate	2,3	Inorganic	—	—	—	—	—	—	—	—	—	—	—	—	—
Sulfide	2	Inorganic	—	—	—	—	—	—	—	—	—	—	—	—	—
Thallium (soluble salts)	2,3	Inorganic	—	—	—	—	—	—	—	—	—	—	—	—	—
Thallium (soluble salts)	5	Inorganic	7.00E-05	—	Same	—	—	—	—	—	—	—	—	—	—
Tin	2	Inorganic	—	—	—	—	—	—	6.00E-01	6.00E-01[a]	Same	—	—	—	—
Uranium (soluble salts)	1,3	Inorganic	—	—	—	—	—	—	3.00E-03	6.00E-04[a]	Less	—	—	—	—
Vanadium, metallic	2,5	Inorganic	—	—	—	—	—	—	7.00E-03	7.00E-03[a]	Same	—	—	—	—
Zinc (metallic)	2,5	Inorganic	—	—	—	—	—	—	3.00E-01	3.00E-01[a]	Same	—	—	—	—

a. Footnote information is found in HEAST (EPA 1995).
b. Aroclor-1260 was sampled for, but not detected at WAG 5.

COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
HEAST = Health Effects Assessment Summary Table
RfD = reference dose
WAG = wastes area group

Table A-4. Evaluation in changes in total risk due to changes in inhalation slope factors.

	Group 1						Group 2		Group 3		Group 5	Group 6	
	ARA-01	ARA-02 Soils	ARA-02 Seepage Pit	ARA-03	ARA-16	ARA-23	ARA-12	ARA-24	PBF-10	PBF-12	PBF-21	PBF-22	PBF-26
Inhalation risk	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	2.E-06	2.E-06	3.E-18	3.E-18	2.E-17	2.E-07	2.E-07
Total risk	8.E-04	4.E-04	2.E-03	2.E-05	4.E-04	1.E-04	2.E-03	2.E-06	2.E-05	2.E-05	1.E-05	2.E-04	3.E-04
Percent of total	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	100.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Original Results													
Aroclor-1242	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254[a]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.E-09	5.E-09
Arsenic	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	NA	NA	NA	NA	NA	2.E-07	2.E-07
Cadmium[b]	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA	NA	NA
Chromium-III	9.E-10	9.E-10	9.E-10	9.E-10	9.E-10	9.E-10	2.E-07	2.E-07	NA	NA	NA	NA	NA
Chromium-VI	6.E-09	6.E-09	6.E-09	6.E-09	6.E-09	6.E-09	1.E-06	1.E-06	NA	NA	NA	NA	NA
Thallium[c]	5.E-09	5.E-09	5.E-09	5.E-09	5.E-09	5.E-09	NA	NA	NA	NA	NA	NA	NA
Sum	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	1.E-06	1.E-06	0.E+00	0.E+00	0.E+00	2.E-07	2.E-07
Recalculated													
Aroclor-1242	4.E-13	4.E-13	4.E-13	4.E-13	4.E-13	4.E-13	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.E-09	5.E-09
Arsenic	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	NA	NA	NA	NA	NA	2.E-07	2.E-07
Cadmium	6.E-11	6.E-11	6.E-11	6.E-11	6.E-11	6.E-11	NA	NA	NA	NA	NA	NA	NA
Chromium III	NTD	NTD	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA
Chromium VI	5.E-11	5.E-11	5.E-11	5.E-11	5.E-11	5.E-11	1.E-08	1.E-08	NA	NA	NA	NA	NA
Thallium	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA	NA	NA
Sum	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	1.E-08	1.E-08	0.E+00	0.E+00	0.E+00	2.E-07	2.E-07

a. Although the aroclor-1254 slope factor for inhalation was not presented, it was calculated in Table B-85 of DOE-ID (1999). It appears that the currently accepted value (0.35 1/[mg/kg-day]) was used.
b. Although a cadmium slope factor was presented, it was not calculated.
c. Although a thallium slope factor for inhalation is not presented in Table B-20 of DOE-ID (1999), the ingestion slope factor was used.
Group 3 risk from inhalation is due to radionuclides (see DOE-ID 1995, Table B-85)

ARA = Auxiliary Reactor Area
COPC = contaminant of potential concern
DOE-ID = U.S. Department of Energy Idaho Operations Office
NTD = no toxicity data
NA= not applicable (COPC not detected at site)
PBF = Power Burst Facility

Appendix B

Activities Completed since September 30, 2004

Appendix B

Activities Completed since September 30, 2004

Waste Area Group 1

Since September 30, 2004, the following activities have been performed at Waste Area Group (WAG) 1:

TSF-26 – PM-2A

- Shipped PM2A Tanks V-13 and V-14 to the Idaho CERCLA Disposal Facility (ICDF)
- Disposed of Tank V-13 at the ICDF
- Designed and constructed Tank V-14 contents' treatment process
- Treated Tank V-14 contents.

TSF-09/18 – V-Tanks (V-1, V-2, V-3, and V-9)

- Excavated the soil to the top of the V-Tanks
- Removed and disposed of ancillary piping
- Constructed the waste transfer and treatment system
- Removed the waste from Tanks V-1, V-2, and V-3 to the treatment/consolidation tanks
- Began treatment of the consolidated V-Tanks waste
- Disposed of the caustic tank (V-4)
- Disposed of the V-Tanks sand filter.

Operable Unit (OU) 1-07B Remedial Action Reports

The following interim remedial action reports have been completed since September 30, 2004:

- *In Situ Bioremediation Interim Remedial Action Report, Test Area North, Operable Unit 1-07B*, DOE/NE-ID-11221, Rev. 1, June 2005
- *Monitored Natural Attenuation Interim Remedial Action Report, Test Area North, Operable Unit 1-07B*, DOE/NE-ID-11229, Rev. 0, August 2005.

Waste Area Group 2

Since September 30, 2004, the following activities have been performed at WAG 2:

- Completed two new perched water monitoring wells (TRA-1933 and TRA-1934)
- Installed petro traps in the TRA-1933, TRA-1934, and PW-13 wells to collect free-phase diesel product
- Initiated monthly monitoring in November 2004 for the presence and thickness of free product in the TRA-1933, TRA-1934, and PW-13 wells.

(A detailed discussion of the petro trap monitoring and interface probe monitoring is presented in the *Annual Groundwater Monitoring Status Report for Waste Area Group 2 for Fiscal Year 2005* [ICP/EXT-05-00967].)

Waste Area Group 3

Since September 30, 2004, the following activities have been performed at WAG 3:

- Implementation of Phase I of OU 3-13, Group 3, Other Surface Soils Remediation Sets 1–3, began in accordance with the *Operable Unit 3-13, Group 3, Other Surface Soils Remediation Sets 1–3 (Phase I) Remedial Design/Remedial Action Work Plan* (DOE/ID-11089). The status includes the following:
  - Completed remedial actions at the CPP-67 site
  - Prepared the *Site Completion Report for Area CPP-67, WAG 3, OU 3-13, Group 3 Other Surface Soil* (DOE/NE-ID-11234)
  - Initiated remediation at the CPP-34A and CPP-34B sites, including the following:
    - Collection of confirmation samples for ICDF approval process
    - Excavation and hauling of contaminated soil to the ICDF
    - Collection of verification samples
    - Backfilling of the excavation with clean dirt
    - Cleanup (activities are currently ongoing and expected to be complete by the end of the 2005 construction season)
  - Completed characterization activities to support waste profile development for CPP-92, CPP-97, CPP-98, and CPP-99. This waste is planned for disposal at the ICDF.

Additional activities planned for the 2005 construction season include the following:

- Collection of characterization samples for the CPP-34b and CPP-34c sites
- Initiation of remedial actions at the CPP-92, CPP-97, CPP-98, and CPP-99 sites.

The remaining Group 3 sites will be included in Phase II.

NOTE: *The CPP-81 site consists of a vent off-gas pipe from Building 637 at the Idaho Nuclear Technology and Engineering Center. The OU 3-13 Record of Decision (ROD) signed in October 1999 stated that there was insufficient information to make a decision on the CPP-81 site and that it should be included for further evaluation under OU 3-13. The explanation of significant differences (ESD) to the OU 3-13 ROD signed in January 2004 assessed previous decontamination efforts for this pipe, including five nitric acid flushes, 14 water rinses, and subsequent rinsate sampling and camera inspection. Based on this information, the ESD determined that the site qualified as a no-action site due to the previous decontamination efforts. However, during decontamination and decommissioning (D&D) activities at Building 637 in 2005, the pipe was cut and residual waste was discovered, bringing into question the no-action classification assigned in the ESD. Consequently, the U.S. Environmental Protection Agency (EPA) and the Idaho Department of Environmental Quality (DEQ) have requested that this site be evaluated as a Group 3 site under the OU 3-13 ROD.*

Waste Area Group 4

Since September 30, 2004, the following activities have been performed at WAG 4:

- Installation of two aquifer water monitoring wells (CFA-1931 and CFA-1932), which were also equipped with vapor ports
- Repair of the subsidence at Central Facilities Area (CFA) Landfill III and reporting of the repair in the *INL Sitewide Operations and Maintenance Report for CERCLA Response Actions—FY 2005* (DOE/ID-11249).

Waste Area Group 5

Since September 30, 2004, the following activities have been performed at WAG 5:

- Completed the *Remedial Action Report for the Operable Unit 5-12 Remedial Action* (DOE/NE-ID-11205)
- Completed the *Operations and Maintenance Report for Operable Unit 5-12* (DOE/NE-ID-11228)
- Completed D&D activities pertaining to the Power Burst Facility (PBF) reactor complex (PER-620) in accordance with the requirements delineated in the *Engineering Evaluation/Cost Analysis for Phase 1 of the Decommissioning for the Power Burst Facility Reactor Building (PER-620)* (DOE/NE-ID-11196); Phase I activities completed under a time-critical removal action include the following:

- Removal and dispositioning of low-level radioactive liquids from PER-620
- Removal and dispositioning of liquids in the PER-706 evaporation tank
- Removal and dispositioning of most of the shielding lead and all cadmium sheeting
- Removal and dispositioning of the in-pile tube
- Installation of shielding over the reactor after removal of the reactor vessel water
- Removal and disposing of some radioactive hot spots to reduce worker exposures during removal of shielding lead
- Isolation of utility lines and other piping to the PBF reactor building and weatherproofing it
- Managing and disposing of other waste generated incidental to accomplishing this scope as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste.

Waste Area Group 6

No additional remedial activities have been conducted at WAG 6 since September 30, 2004.

Waste Area Group 7

No additional remedial activities have been conducted at WAG 7 since September 30, 2004.

Waste Area Group 9

No additional remedial activities have been conducted at WAG 9 since September 30, 2004.

Waste Area Group 10

No additional remedial activities have been conducted at WAG 10 since September 30, 2004.

Appendix C

Issues Identified during the INL Sitewide Five-Year Review of 2005

Appendix C

Issues Identified during the INL Sitewide Five-Year Review of 2005

C-1. INTRODUCTION

Table C-1 provides a list of issues identified within each waste area group during the five-year review conducted in the year 2005. Also provided are recommendations for follow-up action, with anticipated completion date, and a qualitative determination as to the protection it provides.

Table C-1. Issues identified during the Idaho National Laboratory Sitewide five-year review of 2005.

Issues	Affects Protectiveness (Y/N)		Recommendations/Follow-up Actions	Anticipated Completion Date	Follow-up Actions Affect Protectiveness (Y/N)	
	Current	Future			Current	Future
SITEWIDE						
Applies to WAG 5 and other INL sites. The EPA guidance for the free release concentration of Cs-137 has been revised to account for the soil shielding factor included in the latest risk models. As a result, institutional controls at the ARA-03, PBF-22, and PBF-26 sites could be discontinued based on the new EPA guidance.	No	No	The DOE with the concurrence from the EPA and the State of Idaho DEQ will evaluate how to best address the impact of the new guidelines on institutionally controlled sites and will determine whether institutional controls should be discontinued at ARA-03, PBF-22, and PBF-26.	Prior to the next five-year review, 2010	No	No
WAG 1						
Establish and maintain the vegetative cover on WAG 1 OU 1-10 WRRTF Burn Pits II and IV.	No	Yes	Revegetation and weed control measures are implemented in accordance with established operation and maintenance requirements. Affected areas will be reseeded with appropriate seed mix for the sites.	Nov. 2009	No	Yes
WAG 2						
Establishment and maintenance of desirable vegetation on the native soil covers for the chemical waste pond, the sewage leach pond, and the sewage leach pond soil contamination area where	No	Yes	Revegetation and weed control measures are implemented in accordance with established operation and maintenance requirements. Affected areas will be reseeded with appropriate seed mix for the sites.	Nov. 2007	No	Yes

Table C-1. (continued).

Issues	Affects Protectiveness (Y/N)		Recommendations/Follow-up Actions	Anticipated Completion Date	Follow-up Actions Affect Protectiveness (Y/N)	
	Current	Future			Current	Future
WAG 3						
(1) Tc-99 is present in the SRPA at 2X the MCLs. Observed concentrations are higher than predicted.	No	Yes	(1) This is being assessed in the OU 3-14 RI/FS. The draft OU 3-14 ROD is scheduled for submittal in December 2006 and will contain groundwater (GW) monitoring/modeling results and will specify the proposed groundwater remedy.	(1) June 2006 release draft proposed plan	No	Yes
			(2) Northern perched water zone is being addressed under OU 3-13 Group 4.	(1 & 2) ROD submittal, Dec. 2006.		
(1) Northern perched water zone has persisted following relocation of the percolation ponds in 2002.	No	Yes		(1 & 2) Remedy implemented, March 2008	No	Yes
WAG 4						
Subsidence was identified at the CFA Landfill III that compromised the integrity of the cover, creating the potential to allow surface water to contact the waste and potentially carry contaminants into the SRPA.	Yes	Yes	The area of subsidence will be filled and repaired in accordance with established operation and maintenance requirements for the CFA landfills.	Nov. 2006	Yes	Yes
WAG 5						
No issues, other than the Sitewide issue were identified during this review.	No	No	NA	NA	No	No
WAG 6						
No issues were identified at WAG 6 during this five-year review.	No	No	NA	NA	NA	NA

Table C-1. (continued).

Issues	Affects Protectiveness (Y/N)		Recommendations/Follow-up Actions	Anticipated Completion Date	Follow-up Actions Affect Protectiveness (Y/N)	
	Current	Future			Current	Future
WAG 7						
Pit 9	Pit 9	Pit 9	Pit 9	Pit 9	Pit 9	Pit 9
The volume of retrieved waste that will require treatment to meet waste acceptance criteria for the Waste Isolation Pilot Plant is unknown, resulting in complications in preparing the cost estimates for Stage III operations and in determining compliance approaches for ARARs.	No	No	(1) This issue is internal to CWI and does not impact the protectiveness of the remedy. Standard estimating practices will be followed to develop a cost estimate for the Stage III operations.	(1) NA	(1) NA	(1) NA
The RAOs, ARARs, and the treatment train identified in the OU 7-10 ROD need to be updated.	Yes	Yes	(2) This issue will be discussed between DOE, the agencies, and the CWI contractor.	Nov. 2008	(2) No	(2) Yes
Pad A	Pad A	Pad A	Pad A	Pad A	Pad A	Pad A
Nitrates continue to be detected in the vadose zone. The significance of these detections needs to be evaluated.	Yes	Yes	(1) The significance of the detections is being evaluated in the context of the entire SDA in the OU 7-13/14 RI/FS.	Nov. 2008	TBD (depends on results of the OU 7-13/14 RI/FS)	TBD (depends on results of the OU 7-13/14 RI/FS)
OCVZ (Organic Contamination in the Vadose Zone) Vapor vacuum extraction with treatment is operating with PRGs that were updated in 2005. These PRGs are a range of carbon tetrachloride concentrations that span Region A and B, Zones 1–3 in the vadose zone. The PRGs are documented in the *Data Quality Objectives Summary Report for Operable Unit 7-08 Post-Record of Decision Sampling* (INEEL/EXT-2000-00814, Rev 2, June 2005). As active extraction continues, the measured subsurface carbon	OCVZ No	OCVZ Yes	OCVZ Being evaluated in the context of the entire SDA in the OU 7-13/14 RI/FS.	OCVZ April 2008	OCVZ TBD (depends on results of the OU 7-13/14 RI/FS)	OCVZ TBD (depends on results of the OU 7-13/14 RI/FS)

Table C-1. (continued).

Issues	Affects Protectiveness (Y/N)		Recommendations/Follow-up Actions	Anticipated Completion Date	Follow-up Actions Affect Protectiveness (Y/N)	
	Current	Future			Current	Future
tetrachloride concentrations need to be compared to the PRGs to determine the effectiveness of the extraction operation. If subsurface concentrations are approaching the PRGs, a decision to shut down the operation for rebound needs to be made. The PRGs need to be assessed to determine whether adjustments are needed and these remediation goals should be referred to as final remediation goals.						
WAG 9						
The sanitary lagoon site (ANL-04) was administratively transferred to OU 10-08 to facilitate closure of WAG 9 and allow for the completion of the WAG 9 Remedial Action Report.	No	No	The sanitary lagoon site (ANL-04) was transferred from WAG 9 to WAG 10 OU 10-08 in 2005. This transition will be documented in the OU 10-08 ROD.	July 2009	No	No
WAG 10						
No issues were identified at WAG 10 during this five-year review.	NA	NA	NA	NA	NA	NA